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The Engineer

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PUBLIC NOTICES

R.A. 2619.

Ministry of Transport.
RYE-WINCHELSEA ROAD.
CONSTRUCTION OF REINFORCED CONCRETE BRIDGE OVER THE RIVER BREDE AT WINCHELSEA.

The Minister is prepared to receive TENDERS for the CONSTRUCTION and MAINTENANCE of a REINFORCED CONCRETE BRIDGE over the River Brede adjacent to the existing Strand Bridge near Winchelsea, East Sussex.

Form of Tender, conditions of Tender, conditions of contract, bill of quantities and specification may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1 (Room No. 135), upon payment of a deposit of £5. This amount will be returned to the tenderer if his Tender is a bona fide one and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.

Copies of the above-mentioned Tender documents will be available for issue and the drawings may be inspected on and after Wednesday, the 13th June, 1928.

Tenders on the official form, each accompanied by a fully priced bill of quantities, must be enclosed in sealed envelopes, marked "Tender for River Brede Bridge," and submitted to the undersigned on or before 10 a.m. on Wednesday, the 27th day of June, 1928. The Minister does not bind himself to accept the lowest or any Tender.

Dated this 5th day of June, 1928.

(Sgd.) H. H. PIGGOTT,
Assistant Secretary.

Roads Department,
Ministry of Transport. 8679

The Director-General,
India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for:—

SCHEDULE 1. BUFFERS, complete with Springs, &c., for Rolling Stock.
SCHEDULE 2. 25-TON STEAM BREAK-DOWN CRANE.

Tenders due on 29th June, 1928, for No. 1 and on the 13th July, 1928, for No. 2.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each schedule. 8795

Wanted for the Indian
ORDNANCE FACTORIES.
GUN CARRIAGE FACTORY, JUBBULPORE, CENTRAL PROVINCES.
An ASSISTANT WORKS MANAGER.

Salary Rupees 550 a month plus £25 a month sterling overseas pay, rising by annual increments of Rs. 50 a month to Rupees 750 plus £25. The appointment is non-pensionable, but there is a Provident Fund, to which Government contributes. Free passage to India is provided and quarters, if available, at a rental not exceeding 10 per cent. of salary. An agreement for five years will be entered into in the first instance.

Candidates must be well educated, must have obtained a University Degree in Engineering or have passed the A.M. Inst. C.E. Examination or have obtained some other corresponding qualification in engineering, and must in addition have had at least 3 years' practical experience of mechanical engineering under a qualified Civil Engineer.

Candidates must be between the ages of 24 and 36 years.

The selected officer will be required to proceed to India by the middle of September.

Applications should be submitted by the 15th July on forms to be obtained from the SECRETARY, Military Department, India Office, S.W. 1. Envelopes should be marked "Recruitment."

Applications from candidates who are outside the limits of age or do not possess the requisite qualifications cannot be considered. 8660

Assistant Engineers (4)
REQUIRED by the GOVERNMENT of the GOLD COAST for a tour of 12 to 18 months' service, with possible extension. Salary £480 a year for three years, then £510, rising to £920 a year by annual increments. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, must be Corporate Members of the Institution of Civil Engineers or hold an Engineering Degree or Diploma recognised as granting exemption from Sections "A" and "B" of the A.M.I.C.E. Examinations. Must be capable of taking complete charge of construction of buildings, bridges and roads, and have a thorough knowledge of surveying, quantities, and measuring up of work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/628. 8735

Civil Engineer Required
by the GOVERNMENT of CEYLON for appointment as Irrigation Engineer for three years' service in the first instance. Salary £500, rising to £900 a year by annual increments of £40 (£600 a year on attaining 30 years of age). Free quarters and free passages provided. Candidates, unmarried, 26 to 31 years of age, must have passed examination to qualify for Associate Membership of the Institution of Civil Engineers or hold professional qualifications recognised by the Institution as exempting from Parts "A" and "B" of that examination, and have had at least three years' practical experience on Waterworks, Drainage, or Harbour and Dock Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/732. 8734

Civil Service Commission.
FORTHCOMING EXAMINATION.
PROBATIONARY ASSISTANT ENGINEERS in the Engineering Department of the Post Office (20-23, with extension in certain cases). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 26th July. 8380

Civil Service Commission.
FORTHCOMING EXAMINATION.
PROBATIONARY INSPECTORS in the Engineering Department of the Post Office (17-20, with extension for service in H.M. Forces). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 12th July. 8366

PUBLIC NOTICES

For Sale.
At NASSAU, N.P., BAHAMAS, B.W.I., ONE 8 Cubic Yard Steel British Harbour Type DREDGER, built in 1923 by Lobnitz and Co., Renfrew, Scotland, and registered at Lloyds as a 100 A1 Class sea-going dredger.

Dimensions of hull, 110ft. by 44ft. by 12ft.
Maximum dredging depth, 35ft.

The Dredger has recently completed important dredging operations in connection with harbour improvements for the Government of the Bahamas. The Dredger has recently been dry-docked and thoroughly overhauled and passed by Lloyds' Surveyors prior to selling. She is a sound, reliable, and economic machine, admirably suited for digging channels or deepening harbours.

For further particulars apply to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1 (quoting "W/Bahamas 875"), or the COLONIAL SECRETARY, Nassau, N.P., Bahamas. 8632

Ipswich Education Committee.
SCHOOL OF ENGINEERING.

GRADUATE in ENGINEERING WANTED, with teaching experience, to commence duties in September next. The person appointed will be employed full time, partly with engineering classes in the daytime for apprentices preparing for the National Certificates in Mechanical Engineering, and partly in evening teaching at the School of Engineering, as may be required. Salary in accordance with the Burnham Scale for Teachers in Technical Schools. Form of application, which should be returned not later than the 22nd June, will be forwarded on receipt of a stamped addressed envelope.

H. ARMITAGE,
Secretary for Education.
Tower House, Ipswich. P4606

The University of Liverpool.
FACULTY OF ENGINEERING.

The Faculty of Engineering invites APPLICATIONS for a MUNITIONS COMMITTEE RESEARCH FELLOWSHIP, tenable for two years. The value of the Fellowship is £250 for the first year and £350 for the second year.

Applications, with an outline of the research contemplated, should be forwarded to the DEAN of the FACULTY before June 25th. 8667

PUBLIC NOTICES

The University of Sheffield.
SESSION 1928-29.
Vice-Chancellor: SIR HENRY HADOW, C.B.E., D.Mus., LL.D.

DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.

The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.

Part-time Courses are arranged for students who desire to take special portions of any of the regular Courses.

In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' Courses of study at the University and six months' practice at the works or colliery each year for a period of four years. During the first year such students should spend three terms at the University.

RESEARCH Fellowships and Scholarships are awarded annually.

The LECTURE COURSES commence OCTOBER 3rd, 1928.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 25th, 1928.

Particulars of Entrance and Research Scholarships available will be sent on application.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to

W. M. GIBBONS,
8633 Registrar.

The Institution of Structural Engineers.
EXAMINATIONS FOR GRADUATESHIP AND ASSOCIATE-MEMBERSHIP.

The next Examinations will be held on Wednesday (Graduateship), Thursday and Friday (Associate-Membership), 4th, 5th and 6th July. Closing date for entries, Wednesday, 27th June. The Examination will be held in London, Loughborough (Leicester), Bombay and such other centres as may be arranged. Syllabus and full particulars on application to the undersigned.

MAURICE G. KIDDY, F.I.S.A.,
Secretary.
10, Upper Belgrave-street, S.W. 1,
31st May, 1928. 8657

PUBLIC NOTICES

City of Cardiff Education Committee.
THE TECHNICAL COLLEGE.
PRINCIPAL: CHARLES COLES, B.Sc. (Lond.).

The SERVICES will be REQUIRED in September next of a FULL-TIME ASSISTANT LECTURER in ENGINEERING, qualified to teach up to Honours B.Sc. standard. The main subjects required will be those of Mechanical and Civil Engineering, but a good knowledge of Electrical Engineering will be a recommendation.

Salary payable according to Burnham Award.

Applications, on foolscap paper, stating age, full qualifications, teaching and other experience, and giving copies of not more than three recent testimonials, should reach the Principal (from whom further particulars may be obtained) on or before Saturday, 30th June.

The successful candidate will be required to pass a medical examination by the Authority's Medical Examiner for Teachers at Cardiff before commencing duties, and to contribute under the Teachers (Superannuation) Act, 1925.

JOHN J. JACKSON,
Director of Education.
City Hall, Cardiff. 8767

Lincoln Technical College.
PRINCIPAL: A. E. COLLIS, M.I. Mech. E.

APPLICATIONS are INVITED for a FULL-TIME TEACHER in the Mechanical Engineering Department for the Part-time Day and Evening Classes, to commence duties on 1st September, 1928. Candidates must possess a Degree and have had a good Workshop Training, Laboratory and Teaching Experience.

An important part of the work is the preparation of students for National Certificates in Mechanical Engineering, in which the local engineering firms are particularly interested.

Salary in accordance with the Burnham Scale for Teachers in Technical Schools.

Form of application, which should be returned not later than Thursday, 28th June, 1928, will be forwarded by the PRINCIPAL on receipt of stamped addressed envelope. 8765

SEVENTH ANNUAL
Engineering Exhibition, Cardiff.
Under the auspices of the
SOUTH WALES INSTITUTE OF ENGINEERS,
In the DRILL HALL (Dumfries-place), CARDIFF, from
NOVEMBER 21st to DECEMBER 1st, 1928
(both dates inclusive).
Open each day from 2.30 to 8.30 p.m.

The COUNCIL of the SOUTH WALES INSTITUTE OF ENGINEERS invite APPLICATIONS for SPACE in the above Exhibition. The last date for receiving applications is August 31st, 1928.

The Exhibition will comprise the following exhibits:

SCHEDULE OF EXHIBITS.

SECTION 1.
Scientific, Measuring and Recording Instruments, as applied to all branches of Engineering.

SECTION 2.—STEAM SECTION.
Water Softening and Cooling Plant. Boilers and Equipment. Pipes, Valves, Separators, &c. Drawings or Models of Modern Engines. Governors and Safety Devices, &c.

SECTION 3.—ELECTRICAL SECTION.
Motors of various kinds and Models of Winders, Switchgear, Cables, Controllers, &c. Electrical Tools and other Appliances. Overhead Lines, Small Motors. Electric Cranes. Telephones and Wireless Apparatus, &c.

SECTION 4.—MECHANICAL SECTION.
Mechanical Transmission of Power Above and Below Ground, and Plant and Equipment connected there with. Bearings, Clutches, Ropes, Belts, Gearing, &c. Air Compressing Plant.

SECTION 5.—WORKSHOP APPLIANCES.
Machine Tools (Small). Lathes and Drills. Hydraulic Tools. Woodworking Machinery, &c. &c.

SECTION 6.—GENERAL SECTION.
Shaft Signalling. Devices to Prevent Overwinding. Models of Pit Cages, Tram Tipplers and Decking Devices. Models of Coke Ovens, By-product and Recovery Plant. Coal Cutting and Conveying Machines. Pumping Plant. Models of Screening, Coal Washing and Sorting, and Stone-dusting Plant. Couplings.

SECTION 7.—METALLURGICAL SECTION.
Furnaces. Plant for Steel, Copper, Nickel, &c., Manufacture. Tin-plate and Galvanising Equipment. Briquetting Machinery. Rolls and Mill Work. Adaptation of Tin-plates and Sheets to Commercial Uses.

SECTION 8.—MARINE SECTION.
Models of Marine Boilers. Models of Marine Appliances for Loading and Unloading Ships. Pneumatic Riveters. Deck and Engine-room Fittings. Oxy-Acetylene Welding Plant, &c.

Forms of application for space, ground plan and other particulars will be forwarded on application to

MARTIN PRICE,
Secretary.
The South Wales Institute of Engineers, Park-place, Cardiff. 8770

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PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for the SUPPLY and INSTALLATION of SOOT EXTRACTION PLANT at the Greenwich Power Station.

The specifications, drawings, form of Tender, &c., may be obtained on application to the General Manager of Tramways, Tramways Offices, Victoria Embankment, upon payment of £2 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same.

Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 9th July, 1928, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
Clerk of the London County Council.

8774

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

C.—FOUR 75-TON BREAKDOWN CRANES.
D.—3000 SCREW COUPLINGS.
E.—26 PLATE GIRDER BRIDGES (60ft. Clear Deck Span).
F.—THREE PLATE GIRDER BRIDGES (80ft. Clear Deck Span).

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 12th June, 1928.

A fee of 20s. will be charged for each copy of Specifications C, D, and E, and of 10s. for each copy of Specification F, which is NOT returnable.

Tenders must be submitted not later than Noon on Friday, 29th June, 1928.

The Directors do not bind themselves to accept the lowest or any Tenders, and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board,
R. C. VOLKERS,
Secretary.

12th June, 1928. 8763

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 29th June, TENDERS for the SUPPLY of :—

1. AXLES for CARRIAGES and WAGONS.
2. TYRES for LOCOMOTIVES.
3. STEEL BOILER TUBES, FLUE TUBES and STEAM PIPES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, S.W. 1,
11th June, 1928. 8753

Borough of Chippenham. WATERWORKS. TURBINE PUMPING PLANT.

TENDERS are INVITED by the Chippenham Town Council from British Manufacturers (who have had experience in the design proposed) for the PROVISION of an INSTALLATION of TURBINE WELL PUMPS.

Particulars can be obtained during usual office hours from Mr. A. E. Adams, M.I.C.E.I., A.M.I.M.E., Borough Waterworks Engineer, Chippenham. Contractors are to submit designs at their own cost.

Sealed Tenders, endorsed "Tender for Waterworks Pumping Plant," with all other particulars, are to be sent in, addressed to the undersigned, not later than Twelve Noon on Tuesday, the 10th of July, 1928.

The Council do not bind themselves to accept any Tender.

A. STRAND,
Town Clerk.

Town Clerk's Office,
Chippenham, Wilts.,
June 11th, 1928. 8768

Borough of Swindon. ELECTRICITY DEPARTMENT.

The Corporation of Swindon invite TENDERS for the SUPPLY, DELIVERY and ERECTION of STEAM, EXHAUST, WATER and other PIPE WORK, VALVES, TANKS, EVAPORATORS, &c.

Specifications, forms of Tender and drawings may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on payment of a deposit of £2 2s., which will be refunded on receipt of a bona fide Tender within the prescribed time. The charge for extra copies of the specification will be 10s. 6d. each.

Sealed Tenders, endorsed "Tender for Pipe Work," must be delivered to me at my office not later than 10 a.m. on Saturday, 7th July, 1928.

The lowest or any Tender will not necessarily be accepted, and the Corporation will not consider any Tender which is not in accordance with the specification.

W. H. BENTLEY,
Town Clerk.

Town Hall, Swindon,
9th June, 1928. 8730

New Zealand Government. TWIN-SCREW LIGHTHOUSE STEAMER.

TENDERS are INVITED from shipbuilders for the BUILDING of a TWIN-SCREW LIGHTHOUSE STEAMER for the Marine Department of the New Zealand Government.

The proposed dimensions of the vessel are :—
Length, 210ft.; breadth, 33ft.; depth (moulded), 15ft. 6in.

Specification with general arrangement sketch may be obtained from the High Commissioner for New Zealand, 415, Strand, London, W.C. 2. A charge of 10s., which will not be returned, will be made for each copy of the specification.

Tenders, together with designs, drawings, schedules, and specifications, sealed and endorsed "Lighthouse Steamer," must be lodged on or before October 31st, 1928, with the SECRETARY, Marine Department, Wellington, New Zealand.

The New Zealand Government does not bind itself to accept the lowest or any Tender. 8728

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. FOUNDRY COKE.
2. SCREWING TOOLS.
3. GRINDING WHEELS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Foundry Coke," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 29th June, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specification No. 1, and of 2s. 6d. for each copy of the Specifications Nos. 2 and 3.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, The Company's Consulting Engineers, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1,
15th June, 1928. 8791

PUBLIC NOTICES

Metropolitan Water Board. TENDERS FOR THE SUPPLY OF STORES, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for the periods of 6 and 12 months, commencing 1st August, 1928 :—

Tender No.
2. Brushes and Brooms.
5. Cotton Waste.
6. Hemp, Rope, &c.
10. Lead, Brass and Glass.
13. Oilman's Sundries.
14. Packings, &c.
15. Paints, &c.
18. Removal of Scrap Iron.
24. Electric Lamps.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board" and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 25th June, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
11th June, 1928. 8756

Southampton Harbour Board.

TENDERS are INVITED for :—
(1) A HINGED FOOTBRIDGE (160ft. in length) and the ERECTION thereof at the Royal Pier, Southampton ; and
(2) For 2 PONTOON TANKS, 20ft. by 12ft. by 5ft., to be delivered afloat at above.

Particulars and forms of Tender (1) and/or (2) may be obtained upon application to the Board's Engineer (Mr. E. Cooper-Poole, A.M.I.C.E.), at the Board's Offices as below, on deposit of £1, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, upon the Board's printed form, endorsed "Footbridge and/or Pontoon Tanks," are to be delivered, addressed to the Clerk to the Board, not later than Twelve o'clock Noon, Wednesday, 4th day of July, 1928.

No pledge is given to accept the lowest or any Tender.

By Order,
W. G. GUBBINS,
Clerk to the Board.

Harbour Offices,
Town Quay, Southampton,
June 12th, 1928. 8786

Harris Institute, Preston.

WANTED, a competent ELECTRICAL MECHANIC in the Engineering Department of the above School, to undertake the Repair and Maintenance of Instruments, Apparatus, and the School Electric Lighting and Power Installation. Applications, stating age, wage required, and giving particulars of training and experience, to be sent with references to the undersigned not later than June 26th.

T. R. JOLLY,
Principal and Secretary.

8759

Hartlepool Port and Harbour COMMISSION.

ENGINEER, SECRETARY, and HARBOUR MASTER (One Post) REQUIRED IMMEDIATELY. Salary £400-£500 per annum, according to experience. Candidates, who must be Associate Members of the Inst. C.E., must have had at least 5 years' practical experience of Dock and Harbour Works. Applications, enclosing statement of qualifications, age, war service, &c., and copies of three recent testimonials, must be received before June 20th.

J. D. HOWKINS,
Secretary,
Hartlepool Port and Harbour Commission.
30, Town Wall, Hartlepool. 8701

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

PRIVATE SECRETARY for Visit to East.—ADVERTISER, Box 8500, ACKNOWLEDGES with thanks APPLICATIONS received and announces that the POSITION has now been FILLED. 8766 A

WANTED, Ambitious YOUNG MAN, About 30, with shop knowledge of Metal Constructional Work and understanding of drawings.
Apply, stating full particulars, BROMSGROVE GUILD, Limited, Bromsgrove, Worcestershire 8787 A

APPLICATIONS are INVITED from Well-experienced POWER ENGINEERS who have extended knowledge of the most modern practice with regard to the requirements of a large industrial concern for Steam, Power, Water, Refrigeration and other Factory Services.—Address applications in confidence, giving full particulars of experience, technical training, professional qualifications, age and salary required, S.E., 8751, The Engineer Office. 8751 A

ASSISTANT ENGINEER REQUIRED, Age 25 to 30, with Shop and Office experience.—Address, stating age and salary expected, 8604, The Engineer Office. 8604 A

ASSISTANT MECHANICAL ENGINEER REQUIRED for large Chemical Works in the Midlands. Applicants should have B.Sc. Degree or equal, and have had one or two years' practical experience.—Address, giving full particulars to ref. H.Y., 8777, The Engineer Office. 8777 A

ASSISTANT REQUIRED to Chief Engineer of North-East Coast Firm of Chemical and Gas Plant Manufacturers. Applicants must have had sound experience of office management.—Write, stating age, salary, experience, Z.C. 919, Deacon's, Fenchurch-avenue, E.C. 3. 8750 A

EXPERIENCED TRAVELLER in Iron and Steel Trades, with knowledge of Foundry Coke, Pig Iron, Steel Plates, Sections and Joists, to work the district of Wolverhampton, Birmingham, Leicester, &c.—Address, stating age, experience, and salary and commission required, P4625, The Engineer Office. P4625 A

ENGINEER, with All-round Experience, Works, drawing-office, &c., REQUIRED by Firm of Commercial Cars Users.—Address fullest details and qualifications, 8771, The Engineer Office. 8771 A

RATEFIXER, Good Man, REQUIRED, Able to make time studies of Machining and Fitting Operations ; must be first-class Mechanic. State full experience, age, salary.—Address, 8779, The Engineer Office. 8779 A

SMART JUNIOR ESTIMATOR, with Sound Mechanical knowledge, REQUIRED for Engineering, S.W. London. State age, experience, and salary.—Address, P4611, The Engineer Office. P4611 A

WORKING ENGINEER ERECTOR for Heavy Machinery REQUIRED in Sussex.—Address, P4612, The Engineer Office. P4612 A

WORKS MANAGER REQUIRED for Factory Producing Moulded Articles from Plastic Material. Must be well experienced in Hydraulic Presses and Plant. Capable of supervising complete organisation and attaining maximum output. Some knowledge of Chemistry and Dyeing an advantage. Commencing salary £400.—Address in confidence, P4580, The Engineer Office. P4580 A

YOUNG ENGINEER REQUIRED in Office of Electrical Works (Slough, Bucks.). Good education and shop experience essential. Knowledge of estimating an advantage. State full particulars of training, age, salary required, and when available.—Address, P4616, The Engineer Office. P4616 A

SITUATIONS OPEN (continued)

WANTED, a JUNIOR DRAUGHTSMAN for London, capable of detailing Fire-tube Boilers, Horizontal and Vertical. Good calculator, neat and accurate draughtsman and thoroughly conversant with up-to-date practice.—Address, stating age, salary, &c., 8741, The Engineer Office. 8741 A

WANTED, a TRACER for a Westminster Office. Must be neat, accurate and expeditious, able to print neatly.—Address, stating age, salary, &c., 8742, The Engineer Office. 8742 A

WANTED, CHIEF DRAUGHTSMAN.—AITON and CO., Ltd., Derby. 8784 A

WANTED, DRAUGHTSMAN with Electric Overhead Crane experience. State age, experience, and salary.—JOSEPH ADAMSON and CO., P.O. Box 4, Hyde. 8775 A

WANTED, MACHINE TOOL DRAUGHTSMAN, experienced ; Manchester district. State qualifications and salary.—Address, 8788, The Engineer Office. 8788 A

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

The Safeguarding of Industries.

ON Monday of this week, June 11th, the Prime Minister received a deputation from the National Union of Manufacturers which waited upon him for the purpose of urging the Government to facilitate the procedure under the Safeguarding of Industries Act. It was stated by Mr. George Terrell, President of the Union, that so far safeguarding duties had been secured only by nine small industries, employing between them from 50,000 to 60,000 workers, or about one-third of 1 per cent. of the total of 16,500,000 workers employed in the country's industries. Numbers of industries, he continued, had either failed to secure the appointment of a committee to inquire into their position in the matter of unfair foreign competition, or if they had secured the appointment of a committee had failed to satisfy the onerous conditions under which the Government was prepared to impose a safeguarding duty. As a consequence, many industries, even although they were sorely pressed, were reluctant to incur the cost and labour of submitting an application to be heard under the Act. The deputation, therefore, urged the Government to adopt a simpler, more accessible and more straightforward procedure than that now laid down. Subsequent speakers gave instances of the manner in which the present procedure under the Act has affected the paper-making, pencil-making, iron and steel, and other industries. Particular attention was paid to the difficulties which those making an application encountered in seeking to obtain information regarding the conditions prevailing in foreign countries. Other speakers dealt with the Government's requirement that the competition complained of must be exceptional before a safeguarding duty could be granted. Mr. Baldwin, replying to the deputation, said that the case which the deputation had submitted called for careful examination on the part of himself and his colleagues.

New and Projected Atlantic Liners.

SPECULATION continues rife in shipbuilding circles regarding the intentions of the White Star and Cunard Lines in the matter of ordering large new express vessels for their Atlantic services. It would appear that the plans of the White Star Line in this respect are more definite than those of the Cunard Company. It is rumoured that the new White Star vessel will be substantially larger than the "Majestic," and that she may be propelled entirely by internal combustion engines. Should it turn out to be the case that her propelling machinery is to be of this type, it does not seem probable that she will be built to establish a new speed record, but in the case of the projected new Cunarder it is suggested that in speed and size she will surpass any vessel of the company's present fleet. Her speed, according to the rumourists, will probably be 27 knots or a little over, in order that she may compete against the two North German Lloyd vessels "Bremen" and "Europa," now under construction and designed to attain 26½ knots. In the United States the adverse report of the Shipping Board is not, it seems, deterring Mr. L. R. Wilder, of the American Brown-Boveri Company, from prosecuting his plans for the establishment of the projected "Blue Ribbon Line," consisting of 33-knot ships, with which a regular four-day service would be maintained between New York and Plymouth. The scheme, it would appear, has a strong financial backing, and with the promise of Government assistance, the opinion has been confidently expressed that work on the first ships will be begun at an early date.

A Record Flight.

ON the morning of May 31st two Australian flying officers, Captain Kingsford Smith and Mr. Charles Ulm, accompanied by an American navigator, Mr. H. W. Lyon, and an American wireless operator, Mr. J. Warner, left San Francisco on a three-engined Fokker monoplane, the "Southern Cross," on an attempt to fly to Australia *viâ* the Hawaii Islands and Fiji. The first stage of the journey, to Honolulu, representing a straight flight of 2100 miles, was completed in 27 hours 27 minutes. The second lap to Fiji, a distance of 3200 miles, was begun on the morning of June 3rd, and was completed in 34 hours 15 minutes. The last lap to Brisbane, a distance of 1550 miles, was begun on the afternoon of June 8th, and was completed in about 20 hours. The total distance covered, about 7000 miles, makes this flight the greatest trans-oceanic flight ever accomplished. On the first stage disaster nearly befell the airmen by reason of their losing their bearings at one point. By means of their Marconi wireless equipment, however, they were given their bearings from the U.S. destroyer "Richmond," and after correcting their course were enabled to land safely at Honolulu. During the second and longest stage, the machine encountered a tropical hurricane, but flew through it safely. For three hours during this stage the machine kept to the track of the wireless beacon at Honolulu. On each of the stages the machine carried about 1200 gallons of petrol. The performance is a notable one, not only because of the distance covered, but because of the number of persons carried on the machine. It is also noteworthy as clearly establishing the necessity for fitting with wireless a machine attempting a long trans-oceanic flight. To the omission of such an equipment on the score of its weight, several of the disastrous failures of last year to fly the Atlantic may reasonably be ascribed.

Liverpool as an Air Port.

FOR some considerable time past certain of the inhabitants of Liverpool have expressed the ambition to make their city a centre of commercial aviation, and to establish an air port within its boundaries. The visit paid to the city on Saturday of last week, June 9th, by Sir Alan Cobham on his Short "Singapore" all-metal flying boat at the conclusion of his African survey flight seems to have lent considerable impetus to the movement. Sir Alan's flight is held to have shown the way to the establishment of an aerial trade route which would bring Cape Town within an eight days' journey of London. Recalling the past history of Liverpool as a seaport, Mr. R. H. Thornton, chairman of the Liverpool Aero Club, urges his fellow-citizens to avoid complacency and to look at aviation as their fathers and grandfathers looked at shipping eighty years ago. He predicts that within ten years it will be a commonplace sight to see ocean-going air liners taking off from and alighting on the Mersey with less fuss and ostentation than attends the departure and arrival of the Atlantic liners of to-day. It is apparently within the ambition of some of those interested in the movement to open up more air services from Liverpool than are at present operated from Croydon, and to establish regular routes not only to South Africa but across the Atlantic. Speaking at a luncheon given in honour of his arrival, Sir Alan Cobham described the cost of commercial aviation as being purely relative. A bridge across a single river might, he said, cost 1¼ million pounds without anyone considering the expenditure excessive. Yet for one million pounds a daily service of aeroplanes could be maintained for six years between Cairo and the Cape.

Photographs by Wireless.

ON Monday of this week, June 11th, a demonstration of the transmission of photographs by wireless was given by Captain O. Fulton at a London stores. The apparatus is designed to enable photographs transmitted from a broadcasting station to be received on an instrument attached to an ordinary valve set. For the purpose of demonstration, the sending and receiving instruments were placed in the same room, and those present were shown the reproduction of photographs on strips of paper placed in the receiving instrument. The photographs in the sending instrument were imprinted on copper foil. The paper, treated with iodine and starch, at the receiving end and the copper foil at the transmitting end were affixed to rotating cylinders in the two instruments, and these cylinders and the needles through which the modulations of light and shade are obtained were automatically synchronised by wireless. The transmission of each photograph occupied about 3½ minutes, and it was stated that the copper foil could be prepared in about 6 minutes. Captain Fulton explained that he had concluded agreements with various broadcasting companies throughout the Continent, and he hoped that the regular broadcasting of pictures and photographs would begin in October. The longest distance over which photographs have been transmitted, in accordance with this particular system, is 650 miles. Several tests made by the Austrian police are said to have shown that finger prints can be transmitted. X-ray pictures, cheques, letters of credit, and constructional drawings also come within the scope of the invention. The transmission of pictures by wireless is not, of course, new, but the special feature of this system would seem to be that it lends itself to broadcasting, and that the receiving apparatus is not unduly expensive.

British Shipping and Shipbuilding.

ON Tuesday of this week, June 12th, in the course of the discussion in the House of Commons on the Board of Trade Vote, an interesting debate arose on the position and outlook of the British shipping and shipbuilding industries. Sir Philip Cunliffe-Lister gave some figures which showed that during the first quarter of this year the vessels under construction in this country represented just under 50 per cent. of the total tonnage under construction in the world, and that during the same period the tonnage on which construction was begun in British yards was 56½ per cent. of the tonnage commenced throughout the world. Continuing, he remarked that British shipbuilders and marine engineers could offer to shipbuilders all over the world a quality, a range of experience, and a variety of design greater than that which could be offered by any other country, and such as had never before been available. It was encouraging, he said, to find that designers, in spite of the difficulties of the times, had preserved the efficiency, vitality and novelty of British shipbuilding. Sir Robert Thomas, himself a shipowner, criticised the President of the Board of Trade because of his unduly optimistic outlook. There was, he said, no sign of improvement in the shipping industry. The tramp steamer, as distinguished from the liner, was the first to feel an approaching slump or a rise in trade. In the ports of the country tramp tonnage was to-day lying idle. A labour member, Mr. Shinwell, taking part in the debate, was responsible for the statement that tramp steamers were to-day not so important as they once were. The increased use of oil fuel, he said, had resulted in increased cargo space being made available on liners, and those vessels were, as a consequence, carrying more cargo than formerly. Mr. H. G. Williams, Parliamentary Secretary to the Board of Trade, sought to controvert Sir Robert Thomas' statement. The quantity of British shipping laid up in our ports in January this year was, he said, 359,000 tons, and was the lowest figure for any year for some time. It was only one-third of the figure for January, 1923, and only one-fifth of the figure for January, 1922.

Safety of Life at Sea.

AT the opening session of the International Shipping Conference, which began in London on Tuesday of this week, June 13th, one of the subjects to which attention was given was the revision of the 1914 convention on safety of life at sea. A report by a committee on subdivision, appointed at the Conference of 1921, was adopted. That report, in effect, is based on the view that it is impossible to eliminate all risk by subdivision, and that by going to extremes it is quite possible to make travelling so expensive that no one will travel. Sir Alan Anderson dealt with the subject from the point of view of the provision of boats and life-saving appliances and fire-extinguishers. He proposed several resolutions, among which was one which specified that the regulations governing the provision of boats and life-saving appliances should not be such as to endanger the safety of the ship herself, that they should not result in undue encumbrance on the decks, and that they should not impede, by the provision of additional boats required to meet the conditions of extraordinary and exceptional disasters, the prompt handling of the boats required for mishaps of a less severe and exceptional kind. It was further proposed that while sufficient life-saving appliances—boats and buoyancy apparatus—should be carried for all on board, the number of boats should be restricted to the greatest number that could be carried under davits, due regard being paid to the safety of the vessel herself and the prompt handling of the boats. It was considered that the davits should be such as to permit the boats to be safely lowered when the ship had a list of 10 deg. and not 15 deg., as had been proposed by the British Government, that it was not possible to maintain in good condition searchlight and wireless apparatus in lifeboats, and therefore that such apparatus should not be required to be fitted, and that the equipment and stores with which lifeboats should be fitted should be made to depend on the voyage of the ship and should be covered by a general rule specifying only minimum requirements. Speaking of the safety actually realised in ships at sea, Sir Alan said that in the past thirty-five years to 1925 the number of people drowned at sea amounted on the average to but one passenger per 20,000,000 passenger miles.

The North-West Midlands Electricity District.

As an outcome of the local inquiry held by the Electricity Commissioners at Stoke-on-Trent, on May 15th, concerning the draft order and scheme for the reorganisation of the supply of electricity in the North-West Midlands Electricity District, and after consideration of the representations made to them in the matter, the Commissioners have made an order giving effect to the scheme. The order has been submitted to the Minister of Transport for confirmation, in accordance with the provisions of Sec. 7 of the Act of 1919. The main outlines of the technical scheme are set forth in an annex to the order which has recently been sent to us. For the transmission of electricity in the district, the standard pressure between phases is to be 33,000 or 22,000 volts, and in the case of secondary transmission lines, 11,000 or 6600 volts. For the purpose of affording supplies of electricity in bulk to authorised undertakers in the district and to supplement existing or sanctioned inter-connecting or bulk supply lines, main or secondary transmission lines will, subject to any variations subsequently approved by the Commissioners, be established to inter-connect the following places:—Stoke and Leek; Stoke and Congleton; Stoke, Newcastle-under-Lyme, and Market Drayton; Stoke and Stone, Stafford, and Uttoxeter; Stafford and Market Drayton; Leek and Congleton; Leek and Uttoxeter; and Uttoxeter and Burton-on-Trent, as far as the boundary of the district. Provision will also be made for the establishment of such other main or secondary transmission lines, as may be necessary for the remaining part of the district.

General Development of the Locomotive.

(By a Continental Engineer).

No. IX. *(Conclusion).*•

AMERICAN LOCOMOTIVES *(continued)*.

THE "Mallet" articulated engine, which has met with so much success on several railway systems in the United States, permits the combination of very great tractive power with desirable flexibility. But it is a very complicated machine, heavy in repairs and slow, the average speed in service being 12 to 15 miles per hour. Now, for goods traffic on single main lines, speed is one of the elements of the capacity of transport. It is questionable, also, whether this type of engine will last, or if it must be regarded as a transitional type.

The extension of the Mallet engine has attained its limit, and some railways are beginning to rebuild some of them on the usual pattern. To mention one example, we should quote the transformed Reading locomotive to a 2–10–2 engine with wide fire-box of course, having a weight in working order of 438,200 lb., and a total wheel base, for the engine alone, of 42ft. 1in. Total heating surface, 5586 square feet; grate area, 108 square feet; diameter of boiler barrel, 102in.; tractive force, 90,500 lb.; diameter of driving wheels, 61½in.

Up to the year 1925 no makers had dared to build non-articulated engines having more than ten coupled wheels, the largest, at that time, being the 2–10–2 locomotive. The first 4–12–2 engines were delivered quite recently to the Union Pacific Railroad by the American Locomotive Company; they will possibly mark a new departure, and they show, in all cases, that, with the American arrangements, an engine having a wheel base of 52ft. 4in. can easily negotiate curves of 5½ chains radius. This locomotive is the most powerful of all the non-articulated engines yet built, though a little less heavy than the recent 2–10–2 locomotive, and it shows on the part of its makers a singular boldness. The total weight in working order is 354,000 lb., corresponding to a tractive effort of 96,650 lb. The coupled wheels have a diameter of 67in., and the permissible speed is 40 m.p.h. Heating surface (superheater included), 8413 square feet; grate area, 108·25 square feet; boiler pressure, 220 lb. The diameter of the barrel of the boiler is 8ft. 9in. at the rear and 7ft. 6in. at the front part.

For such a large engine it has been found advisable to use three cylinders, two outside 27in. by 32in., driving the third coupled axle, and one inside 27in. by 31in., driving the second axle. The boiler is of the wagon top type with large combustion chamber and is fitted with an automatic stoker; equalising beams are fitted on all axles except between the second and third coupled. The bogie and the trailing bissell are of the swing lateral motion type; controlled lateral displacement is allowed on the leading and trailing coupled axles; the fourth drivers are fitted with blind tires, but this, it appears, has been found unnecessary.

One of the best points in the engine is the remarkable increase of grate area and heating surface for a total weight rather less than that of recent "Mountain" and "Decapod" locomotives. It is coupled to a tender, representative of modern American practice, having a tank cylindrical in shape, supported on two six-wheel trucks with a capacity of 15,000 American gallons and a coal capacity of 21 tons. The total wheel base of engine and tender is 91ft. 6½in.

A few words may be added regarding the frames and the boilers. As long as the bar frames were made of wrought iron, including many welded or bolted parts, I think it may be said that the European plate frames were the best, as they formed a complete bed for the engine. Wrought iron frames were liable to have parts working loose or to breakages, and the repairs were difficult. But the use of cast steel frames constitutes a great improvement, and the two systems, American or European, are about equivalent, and result rather from usual practice than from any decided advantage. We cannot in all cases pass over in silence another quite recent improvement of importance which will possibly, when used on a large scale, give an advantage to the American system and which constitutes certainly a remarkable feat in steel casting. It is the one-piece "Commonwealth" locomotive frame or bed-plate, with which several powerful engines of the Southern Pacific Railroad and many others are equipped. This casting combines, in one piece, the usual main frames, the fire-box cradle, brake equaliser and valve gear fulcrums and all the brackets usually cast or forged separately. It means greater strength and saving in maintenance. It represents, in fact, a new and noteworthy departure in locomotive construction, at least in the United States. The Commonwealth Company was already well known for its one-piece locomotive, tender or car trucks, used also in Europe and especially by the Cie. Internationale des Wagons-lits. More recently yet the same firm has produced for large shunting engines (0–8–0)—St. Louis Terminal—one-piece locomotive beds complete with cylinders, valve chests, and steam ports.

• No. VIII. appeared June 8th.

American locomotive boilers are by far the largest built anywhere and have many good features. The wagon top fire-box, so extensively used, is excellent, as it increases the inside height of the boiler, the surface of evaporation at the points where the production is the most active, and the steam space. It is a very interesting complement of the wide fire-box and it could be used with advantage on many European locomotives.

Inside fire-boxes have been the subject for a score of years of many improvements, some being only the development of previous arrangements and others seeming to be the result of recent practice with stationary boilers in central stations. The wide fire-box of to-day contains from four to five longitudinal water-tubes connecting the lower part of the front water space to the top of the back one, being intended to increase the circulation and sustaining a long brick arch or one made of special refractory tiles, and sometimes completed in the front part by short brick walls having air inlets well disposed. In more recent engines, there is a marked tendency to use one or two flattened tubes of large size extending from the base to the crown. In some engines the fire-box doors are arranged to give access of air when necessary. The combustion chamber, almost a standard now, is an excellent device, adding volume to the fire-box and giving a long flame path so that combustion may be complete before the gases enter the tubes over which the work is also well distributed. It also protects the tube plate from direct radiation, and in long engines, now the rule, it avoids excessive tube length. Shaking grates are also in general use; they have been introduced on the Continent and constitute a common feature of French locomotives since about 1910, with good results. The fire-boxes and ashpans are well disposed for giving a free access of air and for dropping the cinders and clinkers. In one word this important part of the boiler, much improved in recent years, is now an excellent apparatus, allowing good and complete combustion.

American engines are generally built without an attempt at refinement, in the meaning ascribed to that word in Great Britain and in France. Non-working parts are often rough, but the essential parts are always well adjusted and finished. The same observation may be said of their maintenance, good and well organised measures being strictly applied. The vital parts are well fitted and maintained in good condition; the valves are perfectly seated. During a long stay and many travels in the United States I never heard unequal blast nor a connecting-rod big end knocking in full gear, and that is something worthy of credit with cylinders of 25in. to 27in. diameter. On several roads the new locomotives, belonging to different types, are designed, as far as practicable, with interchangeable detail parts.

We may conclude by saying that the study of American practice of to-day is always interesting and instructive, though not to be strictly followed, of course, in Europe, where conditions are so different, but as a rich source of information and of possible development in the future. The engines are built on a scale that our railways could not admit and which is not needed. It is an acknowledged fact that most new types of locomotives result from the adoption in other lands of ideas emanating, at least as prototypes, from American design, modified and adapted to European conditions. European engines are built—perhaps too much—as if their life was to be, so to say, indefinite. American locomotives have had, at least previously, a shorter existence, permitting the replacement of them more often with engines of more recent design. Old-fashioned engines have totally disappeared.

As powerful as they may be, American engines are generally driven unsparingly and even roughly; the blast is very strong and, despite the measures mentioned above concerning the arrangement of fire-boxes, the coal consumption is heavy. Some important companies, and the Pennsylvania Railroad especially, are devoting much attention to this last point and investigating the question. The increased cost of the fuel is a new element that cannot be neglected.

CONCLUSION.

The locomotive engine must not be judged by itself, but according to its adaptation to the service it has to perform. Its development is sufficient when it answers the conditions of the traffic, permits the hauling of the heaviest trains on the line at necessary speeds, and has enough elasticity to guard against contingencies and emergencies. The limit is generally attained when the tractive power reaches a figure corresponding to the maximum strength of the couplings, or when its dimensions and weight have respectively come up to what the loading gauge or the strength of the permanent way and bridges allow. Likewise, the stations, the yards, the running sheds are seldom extensible, save at a very high cost, in the thickly populated districts of Western Europe. There must not be, from this point of view, any preconceived ideas, and one must give due weight to circumstances and local conditions. But these conditions themselves are open to change in the same country in not very many years, and the demand for traffic may increase rapidly.

There are several solutions for coping with this traffic, and those adopted in the United States and in Great Britain are precisely the reverse of each other.

The railways of America are principally distinguished by very long distances to be travelled, by the considerable percentage of single lines with heavy traffic as well as steep and very long gradients in the mountain districts, especially in the western part of the country. On these single lines the traffic must be conducted so as to secure the necessary output—a result achieved as regards good transportation by means of very long and heavy trains driven at a speed consistent with these conditions. The cars are of large capacity and the marshalling yards very extensive, having often been established in new districts where the land was of little value. As regards the passenger traffic, thanks to the intercommunication between the cars, the trains could at an early date be made longer than the station platforms. To allow a sufficient speed of goods trains and a great density of traffic, most of them are fitted with the air brake and the central couplings are very strong, permitting the use of tractive forces attaining sometimes 150,000 lb. Coal and fuel oil are cheap. The loading gauge is wider and higher than in any European country, excepting Russia, the early railways having generally avoided complicated works and tunnels. As a result, very powerful engines are not only necessary, but possible.

In Great Britain, more than in any other land, if we except Belgium, the conditions are exactly inverted. The distances are relatively short; the important cities were already extensive, the country well populated, and the land expensive when the first public railways were built. In one word, the conditions were contrary to those of a new country like North America. Thanks to the early development of mining and of various industries, the railways progressed rapidly, but the loading gauge was rather restricted to reduce the initial cost, and by the adoption of raised platforms. This policy, good perhaps in its time, constitutes now a serious inconvenience whatever be the ingenuity displayed to reduce its consequences.

On the other hand, Great Britain is covered with a network of lines and junctions, and, in many districts, of yards and sidings. There is a small percentage of single-track lines, and most important main lines have four tracks. There is a great multiplicity of trains in all directions and every facility is given for their circulation. The traffic may thus be secured with much lighter trains, hauled by engines adequate to it, and designed in proportion with the restricted gauge.

The four tracks, as they are established in England, equipped with the same kind of permanent way and signalling, and the general arrangement of lines and sidings, help greatly in securing the remarkable elasticity of the traffic on main lines, passenger or goods, and dispense with the long and heavy trains common in the United States, which, in this case, would be in the way and rather a cause of obstruction.

Thus, the permanent equipment has widely compensated for other unfavourable conditions, and the American operation methods would be as out of place in England, as they are useful and interesting on the other side of the Atlantic. The present motive power on British railways is perfectly practical and adequate to the kind of service it has to perform, and it is every day increased or improved in the proportion needed. I should even venture to say that, when the structure gauge and the weight limit allow it, the designing of very large locomotives offers less difficulty than of compact engines, submitted to all kinds of limitations or restrictions, and having to develop economically the maximum power per unit of weight, as the British locomotives more particularly have to do. Stated concisely, American practice has a tendency towards the increase of power by the simple process of increase in weight, while English and some continental practice favours extracting the maximum power from an engine of moderate weight. But great progress has also been made in the United States in recent years, as regards the efficiency of the engines, more especially, as we have seen, by obtaining better and more complete combustion.

Continental railways, at least those of Western Europe, are in some respects subject to intermediate conditions, or rather would be so, if the maximum permissible load was higher. Thanks to a greater number of coupled axles, quite recent engines may be very powerful. The "Mountain" types of two French railways have an adhesive weight of over 74 tons, and for the decapod goods engines, this figure amounts to 85 tons. But the main lines of France now admit axle loads higher than those allowed elsewhere on the Continent, and very near to what is permitted in Great Britain.†

In a word and to conclude, it may be said that the locomotive engine has always, since its creation, answered to the increasing demands of the traffic and has often preceded them. It has undergone a development, as regards power and capacity, which could not have been foretold, not only, of course, in the

† I cannot say about the bridges; but my conviction is that the British permanent way could admit sensibly heavier axle loads for the engines. On the other hand, perhaps the excellence of the road beds is partly due to its never being overloaded, not only by the locomotive wheels, but also owing to the light wagons and the general use of bogie carriages.

beginning of the railways, but only a quarter of a century ago, and it has not said its last word, being always susceptible of improvement, though it can now handle all the trains that other conditions allow.

It is a practical and strong prime mover, independent of all central source of energy, self-contained and compact, and is really a very perfect machine, the work of several generations. As said above, its study has never offered such interest as now. For main line services, it can successfully compete with any other means of traction, even as regards fuel economy, if we except some exceptional countries endowed with abundant water power which can be developed with a not excessive capital expenditure. It cannot be proved, I believe—excepting, of course, metropolitan or suburban railways, on which it has made such a considerable progress, and some lines with very heavy gradients—that electrification has resulted in an increase of weight or speed of the trains, or of regularity in the traffic, and, if the power is produced in heat stations, in any economy on the contrary. As longs a energy is produced mainly by a thermic process, and no scientific fact allows us for the present to foresee any other operation method, the steam locomotive, far from being threatened in its extension, will keep its position and remain the motive power *par excellence* of railways for main line service, passenger or freight, in most countries.

Rural Electrification at Chester.

THE supply of electric current to country parts is a matter that is very much to the fore at the moment, and many who, up to the present, have not even been provided with a supply of gas, are looking forward to the day when they will enjoy the advantages of electricity. It will probably be a very long time before this country is fully electrified, and current becomes available in all small villages, but certain enterprising engineers are, nevertheless, running overhead lines in thinly populated areas for power and lighting purposes. One of these engineers is Mr. S. E. Britton, of Chester, who, in spite of all the rules and regulations and wayleave difficulties, has now erected about 70 miles of high and low-tension lines, which embrace an area of approximately 100 square miles.

Realising the desirability of extending its electricity undertaking over a larger area than that supplied

FIG. 1—RECENT LOW-TENSION LINES

originally, the Electricity Committee of the Chester City Council made an application some few years ago for a special Order to supply current to the urban district of Hoole, and parts of the rural districts of Chester, Tarvin, and Hawarden. With the exclusion of the part relating to Hawarden, an Order was granted in 1923 for an area of 60·9 square miles, and subsequently an underground distribution system was established in the urban district of Hoole. An overhead system was also provided in the parishes of Newton, Upton, Hoole Village, and Mickle Trafford. This was followed by the erection of an overhead 6600-volt transmission line in the north-west direction from Chester to Beacon, Saughall and Mollington. Subsequently, a 6600-volt line was run in the eastern parts of the area, namely, to Littleton, Guilden, Sutton, Barrow and Tarvin; whilst at a later date another line, working at this voltage, was put up in the southern part of the area from Chester to Balderton, Eccleston and Eaton. The foregoing lines have since been extended to Saighton, Waverton, Cotton Abbotts and Cotton Edmunds, and interconnected into the Tarvin line at Stamford Bridge, the latest extensions being from Mollington to Capenhurst, and from Stamford Bridge to Mickle Trafford to augment the original supply in this locality.

From the map, Fig. 2, on which some of the places mentioned are shown, it will be seen that the supply derived from the power station at Queensferry is transmitted by means of a 33,000-volt overhead line to a sub-station known as the New Crane-street sub-station in the city of Chester. This line, which does not, of course, form

FIG. 2—MAP SHOWING OVERHEAD LINES AND SUB-STATIONS ROUND CHESTER

part of the rural electrification scheme, but which merely brings the current to Chester, was completed at the end of 1921. From the main New Crane-street sub-station, the 6600-volt overhead transmission lines are supplied, and these lines feed a number of outdoor sub-stations which give the three-phase four-wire low-pressure rural supplies. The outdoor

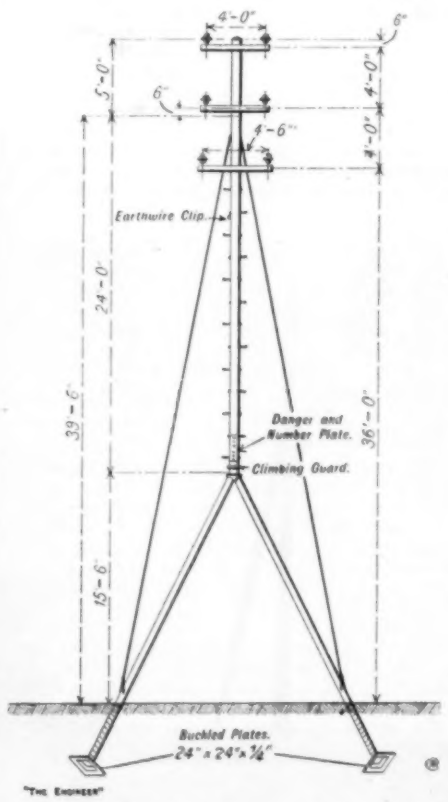


FIG. 3—CALLENDER KAY TRANSMISSION LINE POLE

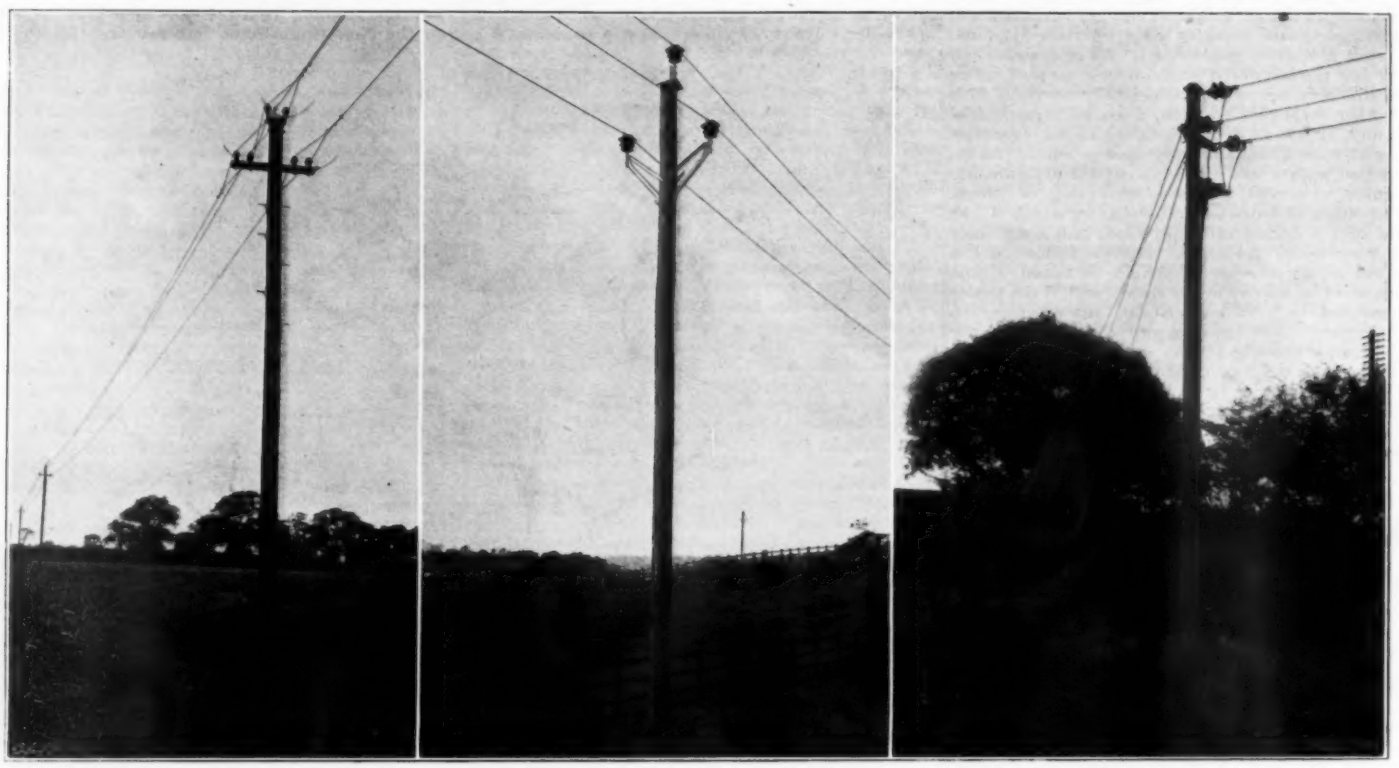
sub-stations already in operation are indicated by the black dots on the map, whilst the white circles indicate sub-stations that are to be added. The low-pressure distribution system works at 400–230 volts. For the most part the low-pressure lines have been erected to comply with the Electricity Commissioners' regulations, issued in 1923, but the more recent lines—see Fig. 1—have been put up in conformity with the new regulations which have recently been published, and which permit of the use of shorter poles and do not call for the "V" guard. Before considering the 6600-volt lines, however, and the lines that give the low-pressure supplies, we will deal with the 33,000-volt line running from the Queensferry power station to the New Crane-street sub-station. All the lines were erected by Callender's Cable and Construction Company, of Hamilton House, Victoria Embankment, and when the low-pressure work is completed, the scheme will constitute one of the most extensive systems of rural electrification in this country.

The 33,000-volt line is approximately 5 miles long, and it is carried on Callender Kay poles, which are also in use at Preston, Kilmarnock and elsewhere. A fair amount of overhead work involving the use of these poles has also been carried out abroad. As these poles may not be known to all our readers, a brief outline of the general design may prove of interest. A drawing of one of the poles as employed on the Queensferry–Chester line is shown in Fig. 3, where it will be seen that the pole is a combination of struts and ties. Generally, the struts are composed of high-tensile tubes which are light and easily handled. The foundations consist of buckled plates, which are attached to their respective tubes by bolts. The joint where all the five tubes come together is simple, and consists of a block of cast iron which calls for no machining or fastening of any kind. The various projections of this block easily fit into the tubes, and the material of which the block is made is subjected to simple compressive forces. Galvanised wire ropes of high-grade steel form the ties, the tensile strength of the individual wires being about 100 tons per square inch. The design results in a structure that does not, under ordinary conditions, call for concrete foundations, which is independent of changes of temperature, and in which there is never any reversal of stress. No matter in what direction the load is applied to the pole, the effect is to compress the tubes and to pull on one side of the stays, whilst if any internal stress is put on the structure during erection by undue tightening of the stay wire, the stress is relieved as soon as the external load comes on the pole. Another advantage of the construction is that in the event of any settlement in the ground that affects the foundation of the inclined members, the stays are affected to the same extent.

Although the poles have four spreading legs, it is said that, generally speaking, farmers do not object to them, as they can work on the land between the legs without much difficulty. As will be seen from the drawing, the three conductors of each of the two three-phase circuits are arranged vertically. The conductors consist of 6 × ·10 square inch stranded wires, with a No. 3 S.W.G. solid copper earth wire below them. In all there are fifty-three poles spaced at intervals of approximately 450ft. As the whole of the Chester supply, as well as that of the outlying districts is dependent upon this line, every precaution had to be taken to make it reliable and to avoid trouble caused by birds. The Callender-Bull bird guard that has been employed throughout the length of the line, is said to have proved perfectly satisfactory.

The earlier 6600-volt feeder line for supplying the outdoor sub-stations in the rural parts were of the simplest possible design. The conductors were carried

on single-member wood poles, as shown in Fig. 4, the size of the conductors varying from 0·05 to 0·1 square inch cross-sectional area. Latterly, however, conductor. The minimum clearance between any line and the ground is 20ft. The bracket arms are built up of angles and channels, as shown in Fig. 5, half the sheds of every insulator smashed, the lines will give satisfactory service during all kinds of weather. Straight line insulators are screwed directly



FIGS. 4 TO 6—6600-VOLT OVERHEAD TRANSMISSION LINES

the Chester Corporation has adopted with a few exceptions the Callender standard wood pole construction, as shown in Fig. 5. In place of the longitudinal earth wire usually employed earth plates are used at each pole throughout the system. Moreover, single-member terminal poles have been used instead of the H type of pole. This arrangement is shown in Fig. 6, where it will be seen that the conductors are made off in triangular formation from double strain insulators, as shown in Figs. 6 and 7. No trouble has been experienced, and, needless to say, the construction has resulted in considerable economy in capital outlay. Almost all the troubles on an overhead line are attributable to birds and broken insulators, but it is said that on the lines under consideration these troubles have been practically eliminated. The poles are composed of imported red wood creosoted by the Ruping process. The under bark is completely removed, and the base of each pole is the natural butt of the tree; all notching and drilling is done before creosoting. A and they are designed to eliminate trouble due to birds sitting on the cross arms and insulators. The channel section top pole fitting carries the top conductor

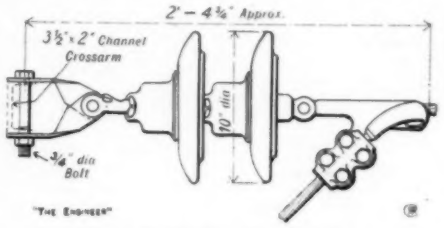
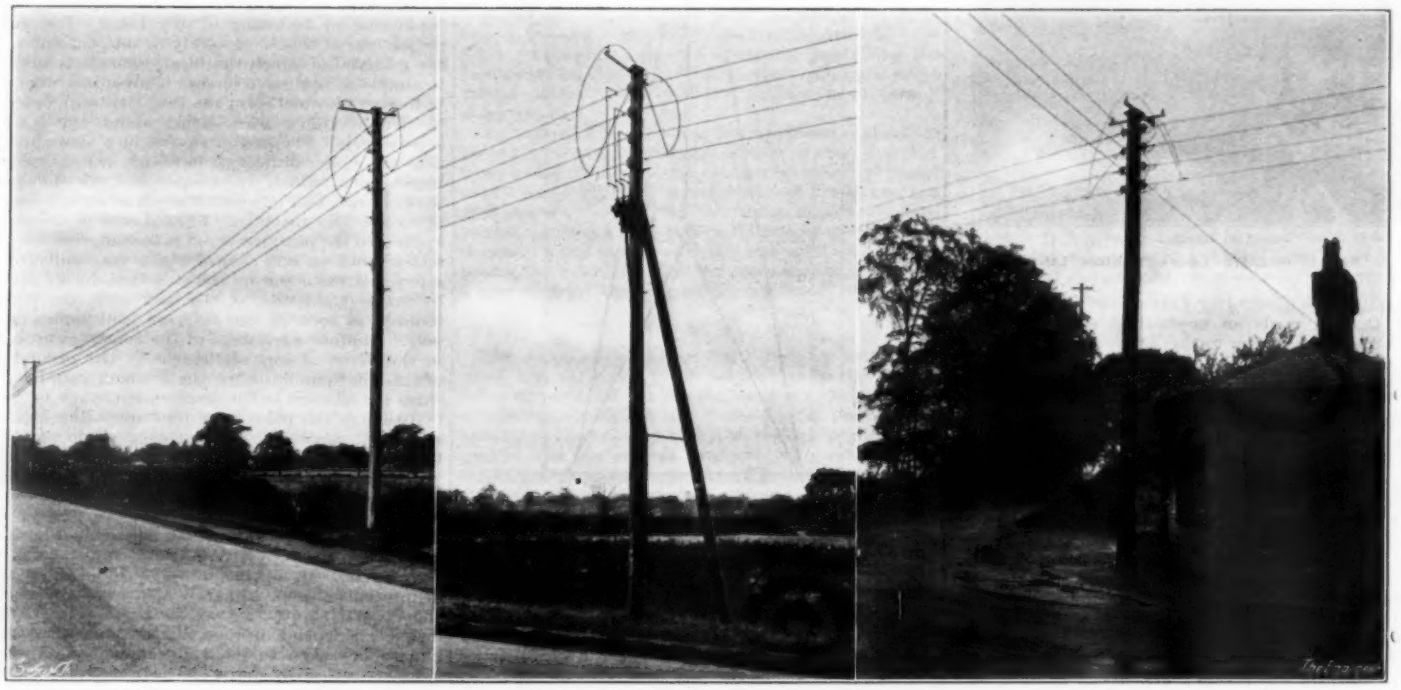


FIG. 7—STRAIN INSULATOR

at a height above the pole roof that is sufficient to prevent a bird earthing the line. A pole cap, composed of asbestos cement, is fastened to the pole by on to a cast lead threaded cap fixed on the top of the galvanised steel pin which is secured to the fitting by cap nuts in order to protect the threads from corrosion and the nuts are locked by spring washers. The end strain insulators—see Fig. 7—are metal-hooded, 10in., porcelain discs, with galvanised fittings. All the conductors are composed of bare hard-drawn high-conductivity copper. On straight line sections of the route, they are carried in the top groove of the pin type insulators, whilst at angle or road crossing positions where bridles are used, the conductors are placed in the side groove of the porcelain. In both cases, however, they are secured by a soft-drawn binding wire, part of which is formed into an effective chafer.

At road and footpath crossings the line conductors are bridled on duplicate insulators carried on a stiffened mild steel plate, secured to the bracket arm or pole fitting as the case may be. A bracket attached to the plate carries a copper earthing bar below each conductor. Gun-metal clamps secure the bridle



FIGS. 8 TO 10—LOW-PRESSURE OVERHEAD TRANSMISSION LINES

uniform equilateral wire spacing of from 3ft. to 4ft. has been adopted, and on flat level ground the span varies from 190ft. to 250ft., according to the size of means of galvanised steel nails with lead heads.

The rating of the insulators under severe weather conditions is extremely conservative; in fact, with wire to the main conductor. Angles in the lines are dealt with by single-member poles, strengthened by one or more stays. Every pole is provided with a

danger plate and a galvanised wire climbing guard.

The low-tension lines, examples of which are shown in Figs. 8–10, are quite simple, especially those that have been erected recently—see Fig. 2—for the Trotter guard has been eliminated, and, in accordance with the latest regulations, the ground clearance has been reduced. It has now been found possible to introduce three sizes of poles, giving 19ft., 17ft. and 15ft. ground clearance respectively. The size of the conductors varies from No. 4 S.W.G. to No. 1 S.W.G., according to the load. When designing the first lines it was found more economical to employ a standard size of pole suitable for all the conductors, and the strength of the pole was calculated on the basis on the largest combination of conductors, viz., three No. 1 S.W.G. conductors with the neutral, whilst the height of the pole was calculated on the smallest combination of conductors. When the work was begun some five years ago, a split neutral system was adopted and loop guards were provided for protection purposes, but it was found that during rough weather these guards were a source of trouble, and tended to foul the phase wires. In order to obviate the difficulty, the neutral wire was placed below the main conductors which were arranged in vertical formation, as

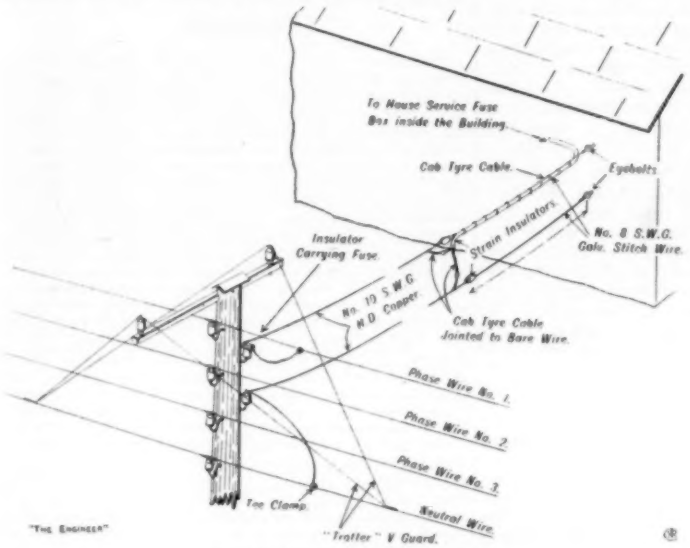


FIG. 11—SERVICE CONNECTION

shown, and Trotter guards were introduced. Under the new regulations, however, these guards are no longer necessary. The illustration, Fig. 8, shows a straight run of wood poles; Fig. 9, a service cable connection; and Fig. 10, a "T" pole at Vicars Cross.

An advantage of overhead distribution, apart from its relative low cost as compared with cables, is, of course, the ease with which service connections can be made. Whereas with cables it is necessary to open up the road, with the overhead system the lines are simply tapped, as shown in Fig. 11. When power is required, three-phase current is supplied and three conductors are taken into the building. Lighting consumers, on the other hand, are supplied with single-phase current from one of the main conductors and the neutral.

In all, there are twenty-three simple and cheap outdoor sub-stations, varying in capacity from 15 kVA to 200 kVA. The transformers are simply enclosed by fencing and the pole type isolating switches are operated by rods from below in the well-known manner. Many country houses are now fed from these low-pressure lines, and many farmers have also availed themselves of the supply. Up to the year ending March 31st, 1928, 106 farms were connected, and during the year 1927–1928 180,831 units were consumed by the farms.

Selling the Gas Engine Abroad.

By A SALES CONSULTANT.

THE development of an export trade in gas engines is not one of the easiest of tasks. For many years this class of motive power suffered from the drawback that suction gas producers were only suitable for a limited range of fuels, and that fact lent special strength to the competition which had to be faced both in steam and oil engines.

The present time, which is marked by a decided revival of interest in export trade and its problems, seems an opportune moment for briefly referring to typical results which were obtainable in the engineering trade before the war. They are the more encouraging in view of the special difficulties which have always stood in the way of any really large development of the gas engine trade. The informal survey which follows covers four years of a soundly conducted campaign, in which every effort was made to profit from experience in machinery of a somewhat similar class, at the end of which period export sales were approximately five times as great as sales in the home market. While total sales were extremely successful, the results were uneven as far as individual markets were concerned, but it needs little export experience to know that those countries which have the largest volume of imports of any particular class of machinery do not invariably furnish the best markets for the individual manufacturer who is starting to develop his trade in such machinery. Export trade is affected by an infinite number of variables, some of the most important of which are the reputation, and the financial resources of the manufacturer concerned, and the peculiar distributing conditions to be found in an individual market.

Exporting Heresies.—As a preliminary it might be useful to refer to certain other of the most frequent misconceptions on this subject which are occasionally encountered in small manufacturing circles. In the first place the export field is not one which will respond to any sudden and spasmodic attempts. Even in pre-war times it usually required two or three years of continuous effort before reasonably large results were achieved, and it is quite certain that no less period would be required under present conditions. Further, the attempt requires adequate financial resources and an efficient organisation to ensure that, as far as possible, the mistakes made by others are avoided. Finally, the export market is not one from which a manufacturer can expect to receive higher prices than he could secure from a home buyer, coupled with the additional advantage of "cash with order" or cash prior to despatch. There are, of course, pleasant exceptions, but it is possible to assert positively that, as a general rule, export prices are lower and export credit is longer than those which are customary in the home market. These remarks may appear truisms, but it is an unfortunate fact that there are many small firms, the turnover of which acquired somewhat fictitious importance during the 1914–1920 period, which have, even yet, hardly accepted the hard fact that the conditions which then prevailed are not normal conditions of trading.

Europe.—The result of selling efforts in all parts of the world showed that European countries offered the largest opening for the sale of gas engines and plant. The three most important were Belgium, France, and Spain, which, after the first few years' preliminary work, took approximately equal numbers. No special technical difficulties were encountered in any of these countries, and commercial problems were mainly concerned with the difficulty of finding first-class agents or distributors who were not already tied to competing makers, and securing an agreement upon the length of credit which would have to be given in this trade. It was finally found to be possible to transact a steady trade in Belgium on the basis of comparatively short credit up to three months, in France normal credit up to six months, and in Spain long credit of nine or twelve months. British exports of gas engines to the two latter countries during the last few years have been :—

	1923.	1924.	1925.	1926.
	£	£	£	£
France ..	16,029	11,759	14,831	9,188
Spain ..	23,337	13,750	7,800	8,222

Portugal offered a market only a little inferior in value to any of the three countries first mentioned, the distinguishing feature of the trade there being the large proportion of town gas engines sold. The length of credit required was normal. Exports of gas engines to Portugal have declined seriously of late years, the exact figures being :—

1923.	1924.	1925.	1926.
£5,226 ..	£6,208 ..	£3,660 ..	£2,905

The trade with Scandinavian countries only reached small proportions, but its slightness was compensated to some extent by the fact that it could be transacted upon, practically, a cash basis. Of the three countries Denmark was the most important.

The number of engines it was found possible to dispose of in the Netherlands was approximately equal to the whole of the Scandinavian trade, to which it bore a superficial resemblance in that it was transacted, practically, upon a cash basis and was a uniformly straightforward and satisfactory business. British exports of gas engines to the Netherlands of late years have been :—

1923.	1924.	1925.	1926.
£5,595 ..	£4,820 ..	£1,278 ..	£2,754

The Balkans.—Machinery trade with the Balkans always presented certain drawbacks, the chief of which were the inordinately long credit which had to be given before any large volume of trade could be developed, and an extreme element of risk. In the development of the gas engine trade, Turkey was found to be the most satisfactory market, taking into account the amount of trade, the credit accorded, and the risk. As far as sales were concerned that country accounted for about two-thirds of the number sold in France, but they were effected through a large number of agents or distributors, each one situated in a port town and working merely the city and vilayet.

In Roumania, as far as internal combustion engines were concerned, the crude oil engine held the field, but both there and in Bulgaria there was found to be a certain market for benzine engines operating upon spirit of a specific gravity of 740–750. Though this would not normally be considered as coming within the gas engine field, the trade is worthy of note, as the average town gas engine can, by the addition of a suitable carburetter and without any change in design, be made to serve excellently as a benzine engine.

The drawback of this market was the extreme length of credit necessary, as well as the risk, and post-war events in this country have certainly done nothing to modify the natural distrust with which the machinery trade in this quarter is regarded in well-informed engineering circles. British exports of gas engines to Roumania during the last few years have been :—

1923.	1924.	1925	1926.
£4,495 ..	£5,787 ..	£13,486 ..	£21,207

Russia.—As a consequence of newspaper propaganda, there is nowadays a general belief that the export trade with Russia was always so trifling that it could be disregarded as a factor in the export programme. Whatever may have been the case, considering the British export trade as a whole, the machinery trade with this destination was far from trifling for British works engaged in the production of motive power plant and agricultural machinery. For nearly a dozen towns in the east of England, any falling off in the Russian seasonal demand would have for inevitable result short time, and general bad trade throughout the district.

In gas engines the trade was not found to be particularly easy, and it never developed to proportions remotely approaching the business it was possible to secure there in either steam or oil engines for an equivalent selling effort. A certain demand was worked up after a year or two as a result of intensive work, and the only feature of note in this trade was that those English and German makers of gas engines, who were most successful in Russia, had developed their trade largely as a result of having the producer plant manufactured locally by their agents under licence, and relying entirely upon the more expensive engine unit as the basis of their business there.

South Africa.—South Africa has continued to be an important market for engineering material long after the cessation of the original boom period there, when the amazing demand for winding engines and boilers of all types may be said to have laid the foundations of many engineering concerns in this country. For some years during the initial stages of the growth of the gas engine business, it was found difficult to break into this market with the new type of motive power, and final success in this line was due in equal measure to a fortunate choice of local agents and a willingness to modify standard designs to meet local conditions. The main markets as far as gas engines were concerned were the Transvaal and Rhodesia, and the former presents the difficulty of loss of power owing to its altitude of four or five thousand feet. Many engineering and machinery agents on the Rand, with an unpleasant memory of the shortcomings of motive power plant in the way of output when installed under these conditions, prefer to disregard strictly theoretical formulæ, and to make their calculations on the safe side by reckoning a decrease of 3½ to 4 per cent. for each 1000ft., with a further reduction of 8 to 10 per cent. on account of the inferior fuel or charcoal generally used. Any neglect of these factors when tendering for power plant will usually entail unpleasant and expensive consequences.

A very useful modification for plant destined for the Rand can often be made by providing an increase in cylinder diameter, either by fitting the next larger size cylinder to a given engine frame, or by boring out the liner of the standard cylinder to a larger diameter. By a judicious selection of one or the other method, it should often be possible to increase the normal horse-power—calculated at sea level—of a range of sizes from 12 to 20 per cent., without increasing the cost more than a trifling amount in the neighbourhood of 2½ per cent.

British exports of gas engines to the Union of South Africa have shown a steady increase during the last few years, as will be seen from the following :—

1922.	1923.	1924.	1925.
£23,744 ..	£15,375 ..	£36,185 ..	£36,429

These figures are approximately two-thirds of the value of the oil engine exports during the same period.

North Africa.—The north of Africa also presented certain very good outlets for gas engine business, but Egypt, though importing steam and oil engines in huge numbers, was found to be a disappointing market for gas, and only equal to such a country as Denmark. As far as the total volume of gas engine exports are concerned, the position in Egypt shows signs of improvement, the British shipments having been :—

1922.	1923.	1924.	1925.
£4,290 ..	£11,256 ..	£14,772 ..	£33,796

Algeria provided a market for engines and suction

gas plants almost equal in importance to that of France, though necessitating slightly longer credit, and Tunis was another important field.

Australia.—Efforts in the important Australian market yielded results but slowly. This was, of course, merely an individual experience, but the position of the gas engine trade at the time was undoubtedly affected by the fact that the demand for such plant is, on the whole, mainly for industrial purposes, and the call for industrial motive power is much less than it is for agricultural or pastoral work. In Western Australia some very valuable missionary work had been done by one of the largest English makers, who had succeeded in adapting the suction gas plant so as to give successful results upon the local Collie coal, by fitting a rotary tar extractor and other modifications. Mainly owing to the initial spade work on the part of this one maker, the import of gas engines into this State amounted to about eighty engines per annum at the time of which I write.

The present position for gas engines is, on the whole, a reasonably satisfactory one, the total Australian imports of these engines for the fiscal year 1924–5 having been £41,000 in round figures, and for 1925–26 £48,000, the remarkable fact about this trade being that Queensland now takes the largest proportion of gas engines, although before the war that State was the main field for the sale of the old type of portable steam engine and boiler with long log-burning fire-box. British exports of gas engines to the Commonwealth of late years have been :

1923.	1924.	1925.	1926.
£82,871	£40,811	£57,552	£31,003

Gas engine business in Australia has always been overshadowed by the remarkable trade in oil engines which is done there, the total imports of those engines during the years 1924–25 having been £280,000, and during 1925–26 £256,000, of which trade British makers secured by far the largest proportion. The demand is greatest in New South Wales, followed at a considerable distance by Victoria. There are between forty and fifty different makes, all actively represented and pushed. Queensland is the next market in order of importance, followed by South Australia, the peculiarity of the latter being that, for many years, the main portion of the oil engine trade there, was in the hands of not more than three or four main distributors.

New Zealand.—As a contrast, I found New Zealand a much more favourable market for the sale of gas engines. The gas undertakings in that country had at an early date given due consideration to the fact that a 10 H.P. engine operating upon town gas, and costing roughly in the neighbourhood of £75 net before the war, would in the course of the first twelve months—if in regular work—consume gas of a value approximately equal to the first cost of the engine. Many of the gas companies had adopted a progressive policy by installing gas engines which they would supply to power users within their area upon hire-purchase terms, and at prices which were only a little greater than actual cost. In many cases the gas company would hold a sole agency for one maker, so that, in effect, the English maker who had been far-sighted or fortunate enough to conclude a sole agency for a particular New Zealand city would practically have the monopoly of the small gas engine trade in that area, as it would be impossible for another maker or agent to compete with the terms which the gas company could grant to an intending purchaser.

Apart from this special class of large buyers, New Zealand was found a really valuable market for gas engines complete with suction gas producers, but British shipments to that destination in this line during the last few years have, however, declined greatly :—

1923.	1924.	1925.	1926.
£11,342	£5,601	£7,365	£1,154

India.—India has for a great many years been the best market for motive power plant within the British Empire, but I found it difficult to secure an entry with gas engines. The market is an extremely competitive and highly organised one, and a new maker, unless he happens to have something exceptional to offer, will find it difficult to penetrate in the face of the well-organised competition of well-known makes and agencies which have been established there for twenty or thirty years. The gas engine maker is also faced by the prejudice in favour of steam as a motive power, the predominance of which has, by no means, been seriously assailed. An exception to the general partiality of power users for steam plant must, however, be made in the case of Southern India, where the majority of small installations were either crude oil engines or gas engines with combined suction gas plant running on charcoal. Steam installations were little in favour, owing to the high cost of the inferior coal procurable, except in rice mills, where husks were burnt, and the difference of an extra few tons in the consumption had not the same importance as when the fuel was purchased from outside sources. The British exports of gas engines to India of recent years have been :—

1923.	1924.	1925.	1926.
£82,205	£55,561	£44,215	£62,990

Ceylon.—Ceylon, at the time I have in mind, was an impregnable stronghold for oil-burning plant. In the steam engine era, boilers had invariably to be equipped with liquid fuel burning apparatus, and with the coming of the oil engine, certain makers found it one of their best markets. One of the Lincolnshire makers had approximately 500 engines at work in the island at this time, and a Yorkshire maker had disposed of 150 oil engines in a few years through one agency alone.

Efforts to promote the sale of gas engines there proved abortive for many years, as all local engineering firms were unanimous in declaring that there was not the slightest demand for any internal combustion engine but oil; but after four years of unavailing efforts, some genius in the island conceived the notion of utilising cocoanut shells as fuel for a suction gas producer. The attempt was an immediate success, without any of the lengthy experiments and modifications which are usually necessary in such cases, and the local engineering firms, from a previous attitude of bored indifference to the whole subject of gas engines and their possibilities, suddenly began to take a lively and somewhat anxious interest in the possibility of securing an exclusive agency. Orders began to be received not only for small plants, but for installations capable of developing 50 and 60 B.H.P., and in the space of some nine months the island became one of the best markets for gas engines.

The gas engine and suction gas plant have not ousted the oil engine from the position it has long held as the most widely used type of motive power in Ceylon, but it is interesting to note that of late years the gas engine exports to that destination have amounted to roughly one-third of the oil engine shipments, the exact figures being as follows :—

1923.	1924.	1925.	1926.
£10,379	£7,425	£8,532	£23,034

Japan.—Japan was found to offer a good opening, both for town-gas and suction-gas engines, the most noteworthy feature of the trade being the importance of the business transacted by some of the gas undertakings, for the same reasons which prevailed in New Zealand. Judging from a survey of recent Japanese official imports, the proportions of the trade in recent years have been—steam plant 2, gas and oil 1. The imports of gas and petroleum engines—which are unfortunately combined in the official returns—quoted in thousands of yen, have been :—

1922.	1923.	1924.	1925.
2,371	2,732	5,572	5,732

Of the foregoing trade, United States makers secured the largest proportion.

Canada.—I have to confess to a considerable measure of ill-success in all efforts to secure a gas engine trade in this Dominion, mainly owing to the severe competition from the United States. Moreover, at the time I refer to, the gas engine business was rather under a cloud owing to a rival installation of some half-dozen engines and their accompanying plant having been thrown out since they did not give satisfactory results upon the coal available. Considerable publicity had been given to this installation, and the unfortunate results were equally widely known. Largely as a consequence of this, buyers were found at that time to be exacting very stringent conditions in regard to any gas engines installed, a typical instance being an installation of 140 B.H.P. made about that time which had to work for a month eight hours per day, without any involuntary stoppage or failure to start, before a cent was paid on account of the purchase price.

South America.—As far as gas engine business was concerned, South American markets were poor, more especially when results were compared with the large volume of business transacted there in other classes of machinery, most notably steam and oil engines. From individual experience, I would hardly expect South America to absorb 10 per cent. of a maker's total exports in gas engines. Of late years, Brazil has offered the best market for these, British shipments having been :—

1923.	1924.	1925.	1926.
£14,426	£25,361	£30,912	£12,752

These figures considerably surpass the oil engine exports. In the case of another important South American market, the Argentine, the position is reversed, the following figures of gas engine exports being trifling compared with those of oil engines :—

1923.	1924.	1925.	1926.
£20,069	£6,050	£5,550	£1,504

Any manufacturer who is seeking to promote business in South America in machinery of the type under review, should not neglect to explore certain German channels of distribution. Before the war, German merchants and manufacturers had secured a considerable hold upon much of the machinery trade in Latin America, particularly in such countries as Brazil, Chili, Mexico and many of the smaller republics in Central America, and they purchased quantities of British machinery for this destination. Contrary to the popular belief that German machinery is always cheap, and therefore particularly suitable for export markets which are only partially developed, the commercial engineer should bear in mind the fact, that before the war, when certain classes of steam-gas and oil engines were required at a highly competitive price, for markets requiring a robust, simple and easily operated plant, German merchants were accustomed to purchase them largely in Great Britain, and this business formed some of the most straightforward and satisfactory export trade it was possible to secure. The war has, of course, materially altered the course of trade, but it is showing signs of resuming many of its former channels, and during the last two years I have found it possible, as a result of personal visits to Germany, to pick up the threads of some, at any rate, very satisfactory pre-war South American trading connections.

In spite of all competition, it is certain that the gas engine has still a big future, and as a corrective to any pessimism on the subject of export possibilities, nothing could be more valuable than a survey of the trade which has been and which is still conducted in this form of power in all parts of the world. From an initial period, when it scarcely seemed likely that such plant would ever be used in districts situated at any distance from an anthracite colliery or a gas undertaking, technical research, working hand in hand with commercial development, has succeeded in adapting the suction gas plant to such a wide variety of fuels that there is hardly a country in the world which has not a cheap form of local fuel suitable for the production of gas for power purposes.

Extensions at the Shanghai Power Station.

FROM Mr. T. H. U. Aldridge, the Chief Engineer to the Shanghai Municipal Electricity Department, we have received particulars of the extensions that are being made at the Riverside power station. The present capacity of the plant is 121,000 kilowatts, but on account of the increasing demands, it has been necessary to extend the power station and transmission and distribution system. The new plant will consist of two 20,000-kilowatt generating sets and four boilers with a normal evaporation of 140,000 lb. of water per hour and a maximum capacity of 180,000 lb. The boilers are to be fired with pulverised coal in accordance with the Lopulco system. Each boiler will have its own pulverising unit and storage bin for the powdered coal, and, in the event of a pulverising mill breaking down, screw conveyors will supply the burners of adjacent boilers from neighbouring bins. Each boiler will be fitted with an integral economiser and air preheaters. Supplementary 22-kV main switchgear for the control of the two new alternators and several new 22-kV trunk feeders and step-up transformers are to be provided.

Although the original plant works at a pressure of 200 lb. per square inch with a final temperature of 572 deg., it was decided to run the new plant at a higher pressure. The new steam conditions are 375 lb. per square inch at a temperature of 700 deg. Fah. and 350 lb. at the turbine stop valves. By means of reducing valves in the main steam range, it will be possible to make the new boilers supply the older plant at the lower pressure. This will only be done, however, in the case of emergency. Normally, the new plant will be operated as a separate unit, and as a base load plant.

The first of the new turbines which is now being erected is to be bled at two stages for raising the temperature of the condensate for boiler feed purposes to 200 deg. Fah. The second turbine will be bled at three stages to raise the condensate temperature to 245 deg. Fah. Both turbines will be of the two-cylinder or tandem type, and will run at a speed of 3000 revolutions per minute. The maximum continuous rating of each machine will be 25,000 kilowatts, and the best efficiency will be obtained at 16,000–18,000 kilowatts. Experience at Shanghai has shown that large boiler units are preferable to relatively small units, and with the new section of the station running as a base load station with three boilers on load and one laid off for overhaul, sufficient steam will be available to generate 40,000 kilowatts with the boilers operating at their best efficiency viz., 87½ per cent. In the event of one boiler being taken off load, sufficient steam will still be available to generate 36,000 kilowatts by pushing the rating of each boiler up to 180,000 lb. per hour. Two of the boilers with economisers and air heaters will be Babcock cross-drum marine type boilers, whilst the third unit will be a Stirling boiler with a similar economiser and air heater. The fourth unit will be a Stirling boiler equipped with a Howden-Ljungstrom air heater. The furnace walls of all four boilers will be lined with Murray fin water tubes.

The pulverising equipment for the first three boilers will be provided with dryers for drying the raw coal before it enters the mills, but in the case of the fourth boiler, dryers will not be provided, as it is believed that the moisture content of the various coals used is sufficiently low to render dryers unnecessary. Dryers will, however, be added later if experience shows that they are essential. The turbo-alternators are being supplied by the Metropolitan-Vickers Electrical Company, the main 22-kV switchgear by the British Thomson-Houston Company, the auxiliary 6·6-kV and low-tension alternating-current gear by Ferguson, Pailin, Ltd., the direct-current low-tension gear by the English Electric Company, and the auxiliary alternating-current ironclad fuse gear by A. Reyrolle and Co., Ltd. A steam feed pump is being supplied by G. and J. Weir, Ltd., and an electric feed pump by Holden and Brooke, Ltd. Besides the boilers mentioned, Babcock and Wilcox, Ltd., are supplying the steel work for the boiler-house and turbine-room, also the steam and water pipe work; Hopkinsons, Ltd., are supplying the steam valves; W. H. Allen, Sons and Co., Ltd., the condenser water circulating pumps; and the International Electric Company, of New York, the new step-up transformers.

Two of the boilers in the "1920 No. 3" boiler-house, which contains five Babcock and Wilcox and five Stirling boilers, with a normal capacity of 80,000 lb. per hour, have been equipped with Howden-Ljungstrom air heaters, and the efficiency has been raised from 79 to 85 per cent. The improvements which these air heaters have brought about led to the decision to equip the remaining eight boilers with air heaters, two of which are to be installed this year. So far no serious deterioration of the brick furnace lining or of the tuyeres of the Erith-Riley stokers has been observed. The temperature of the inlet air to the furnace is from 280 deg. to 290 deg. Fah.

The Institution of Civil Engineers' Centenary Celebrations.

No. II.*

THE CONFERENCE.

AT THE INSTITUTION OF MECHANICAL ENGINEERS.

At a meeting held on Tuesday, under the chairmanship of Sir John Dewrance, the following paper was presented.

THE PROPERTIES OF MATERIALS FOR USE AT HIGH TEMPERATURES, WITH SPECIAL REFERENCE TO BOILERS FOR SUPERHEATED STEAM.

By R. G. C. BATSON, M. Inst. C.E.

It is now generally recognised by engineers that if the steam engine is to compete effectively with the internal combustion engine the initial temperature of the working fluid must be considerably higher than that which has hitherto been customary. In the development of steam plant to meet these conditions the principal limiting factor is the strength, at these temperatures, of the material used. Modern steam plants employ an inlet temperature of about 750 deg. Fah., and from consideration of the properties of ordinary mild steels at high temperature, a temperature of this order appears to be a maximum. Boiler pressures have advanced in recent years for the larger land plants from 200 lb. to 800 lb. per square inch, with a few cases of much higher pressures up to 1570 lb. per square inch.

Recent research has shown that the tensile strength of materials at high temperature, obtained by the ordinary methods of testing at air temperature, is misleading. It has also been found that at high temperature a stress much lower than the ultimate tensile stress will cause failure of any material if prolonged for some time. This is due to creep or flow of the material with time. Further, it has been shown that for each temperature there is a stress below which the material will not fail or will last for many years. This stress has been called the limiting creep stress.

There is probably a temperature at which, if permanent deformation occurs, failure results. On the other hand, at a lower temperature permanent deformation can occur without failure. This is due to the fact that at such a temperature the material "strain hardens" under stress and temperature, owing to creep or flow without appreciable softening, and the creep ultimately ceases, whereas at a higher temperature there is appreciable softening and flow continues.

The results of tests on steels used for boiler and superheater tubes and superheater and steam drums indicate that there is an extremely rapid decrease in the limiting creep strength as the temperature is raised above 752 deg. Fah. At a temperature of 977 deg. Fah. the actual working stress in boiler tubes may be equal to the limiting creep stress.

Practically all metals are subject to failure by intercrystalline cracking if the temperature is high enough. There is evidence that this type of failure may occur with boiler tube steel at temperatures of about 1112 deg. to 1202 deg. Fah. Further, this steel readily oxidises in the presence of air at a temperature above 1058 deg. Fah. It is clear, therefore, that if working pressures and temperatures are to be raised much above their present limits, say, 800 lb. per square inch, materials other than those now employed must be used for boiler and superheater tubes. For this purpose a material is required which will give the mechanical and physical properties at 932 deg. Fah. obtained with the present low-carbon steels at 752 deg. Fah., but with no—or very small—addition to the cost. That is to say, a limiting creep stress of about 13 tons per square inch is required at 932 deg. Fah., with good ductility at normal temperature.

The position as regards materials other than low-carbon steels is as follows:—

Carbon Steels.—Increasing the carbon content reduces the ductility and increases the limiting creep stress, but only to a very small extent.

Alloy Steels.—Very little information is available on the properties at 932 deg. Fah. and over of steels containing additions of other elements such as nickel, chromium, cobalt, vanadium, &c. The general indication, however, is that: (*a*) the improvement is not appreciable when the amount of the additions is small (3 to 4 per cent.); (*b*) where the amounts added are large the gain in strength is considerable.

Non-ferrous Alloys.—An alloy of 70 per cent. of nickel with 30 per cent. of chromium—in the rolled condition—has been thoroughly investigated, and the results obtained show considerable advance as regards strength at high temperature over other materials which have been considered. Values are given below:—

Nickel-chromium Alloy.

Temperature. Deg. Fah.	Limit of proportionality. Tons per sq. in.	Ultimate tensile strength. Tons per sq. in.	Limiting creep stress. Tons per sq. in.
932	15	45	24
1082	12	40	16
1202	—	35	9
1292	5	29	6

It is thus possible to obtain materials that will meet the requirements for increased steam pressures and temperatures; but, as they involve the use of expensive alloys, their application at present in boiler construction is extremely limited. The present position, therefore, shows the great need for further research in order to obtain a material suitable for the needs of the "power production" industry.

Sir Robert Hadfield said that with the aid of chromium and tungsten metallurgists were endeavouring to meet the new requirements of engineers in the matter of providing steels that were satisfactory at high temperatures as regarded non-scaling and safety. Chromium by itself was not sufficient, but tungsten rendered good service, particularly when added to alloys of iron, nickel and chromium. Referring to nickel, chromium and tungsten alloys, he drew attention to their use for the rotors of superchargers for aero-engines. Such a rotor was to be found among his firm's exhibits arranged for that evening's conversazione. The temperature at which it had to work was of the order of 850 deg. Cent., and the stresses at the root of the blades were estimated to be about 10 tons per square inch. A rotor of the type exhibited had been tested for 250 hours, and after the run showed no change of shape and no signs of oxidation. Steel for such rotors had not only to withstand the high temperatures and speeds imposed when the rotor was running, but had also to show an absence of brittleness at the low temperatures reached at high altitudes when the rotor was not running. Dealing with the new steels for use in turbines, he said that a typical analysis was carbon 0·4 per cent., chromium 11 per cent., nickel 29 per cent., iron 60 per cent. The composition, however, varied with each particular application.

Sir Charles Parsons stated that turbines could be built with ordinary materials to withstand any temperature that steam would produce in them. What most engineers really wanted was a metal capable of withstanding high temperatures that could be drawn into tubes for superheaters. It was very difficult, he understood, to produce tubes in the new steels.

Sir Dugald Clerk discussed the possibility of using the new steels in internal combustion turbines. In the reaction type the plates and blades had to remain constantly immersed in the working fluid, the temperature of which might be as high as 2500 deg. Cent. It was unlikely that we would ever have a material that could withstand such conditions. The alternative was to adopt the impulse principle as Holzwarth had done. The expansion of the gases in the nozzle led to a drop of temperature. The principle was practicable, but the efficiency realised was low and could not compare with that of an ordinary internal combustion engine. Apart altogether from the difficulty of obtaining a metal to withstand the temperatures and stresses found in an impulse internal combustion turbine, trouble was caused by the fact that it was necessary to provide a high pressure turbo-compressor. The efficiency of such a compressor could not be much greater than 70 per cent., as compared with about 95 per cent. for the efficiency of compression in an ordinary internal combustion engine.

Mr. H. N. Gresley said that in the ordinary locomotive very high temperatures were not encountered, but with pressures of 1800 lb., as used in a recent German engine, there was a tendency for the temperatures employed to increase. The usual superheater temperature did not exceed 800 deg. Fah., but there were times when much higher temperatures could arise in the superheater elements, as, for example, when with a heavy fire on the grate steam was suddenly shut off. Locomotive engineers, he thought, would welcome any information that could be given them regarding the phenomenon of creep in cast iron.

Sir William Ellis remarked that the use of the new alloy steels not only raised important cost questions, but also involved difficulties of a purely physical kind. For example, the production in such steels of a drum, 45ft. in length, 4ft. 6in. in diameter, and 4in. thick in the walls, presented great difficulties. The work while it was being produced must never be allowed to become cold wholly or in part. If it were, it would be destroyed. He admitted, however, that for work of less extreme size the new alloy steels were very valuable.

Dr. W. H. Hatfield emphasised the very tedious nature of a test to discover the creep stress limit of a metal, and said that one test alone might last four or five months. As a means of shortening the duration, he suggested that the limiting creep stress could be regarded with sufficient accuracy for most purposes as coincident with that stress which, when applied to a specimen, did not produce an extension in excess of 0·5 per cent. in twenty-four hours, and which caused no farther stretch in the succeeding forty-eight hours. This "time yield figure," as it might be called, was found to approximate very closely to the limiting creep stress, and its use enabled the test to be completed in three days. Mr. Batson's requirement that the ideal steel should be obtainable with little or no addition to the cost was, he held, open to criticism. If a costly power plant were rendered inefficient by reason of faulty superheater tubes, a very small percentage increase in the total cost of the plant involved by the use of expensive alloy steel tubes would be more than justified. Such alloy steels had a strength four or five times as great as ordinary mild steel at temperatures between 500 deg. and 800 deg. Cent.

Dr. W. Rosenhain expressed strong disinclination to accept Dr. Hatfield's proposed method of shortening the time spent in the determination of limiting creep stress figures. At sufficiently high temperatures metals which failed by creep failed by the pulling apart of their crystals, a method of failure which was abnormal in the cold state, and which was not reproduced by specimens subjected to Dr. Hatfield's quick test for creep. He thought that we would ultimately have to be content with using metals at stresses above the creep limit, thereby knowingly reducing their lives. The limitation of the life of metal parts in that way was, he held, essential, not only for financial reasons, but also because otherwise it would not be possible to do what we desired to achieve. We already compromised in the matter of long life in the case of rails, and their resistance to wear, and in the crank shafts of aero-engines stresses, of necessity, were incurred which were to the designer's knowledge above the fatigue limit. In the case of high-temperature steels, we would have to adopt a similar outlook, namely, a perfectly safe, but limited life.

Dr. Batson, replying to the discussion, said that it had brought forth some good suggestions for future research, notably Sir Charles Parsons' remarks regarding superheater tubes and Mr. Gresley's request for information concerning creep in cast iron. It was important, he said, to note that the creep stress figures so far published had been obtained from specimens in an atmosphere of pure air. In practice, the atmosphere might be corrosive, with a consequent serious reduction in the creep strength.

Sir John Dewrance, moving a vote of thanks to the author, raised an important point concerning the practical difficulty of jointing high alloy steel tubes to mild steel headers or other parts. Two materials of widely different compositions could not be jointed satisfactorily, for their differential expansion and contraction were bound to break the joint. That fact presented to his mind a grave difficulty in the way of using alloy steel tubes in superheaters.

Immediately following the presentation of Dr. Batson's paper Sir A. B. W. Kennedy took the chair and the following paper was presented.

THE PRESENT TREND IN BOILER PRACTICE.

By WILLIAM HENRY PATCHELL, M. Inst. C.E.

The big boiler, introduced about twenty-five years ago, was ahead of its time, but it has won through, and instead of there being units producing more than 20,000 lb. of steam per hour in a few localities only, units producing 100,000 lb. of steam per hour and upwards are now quite common, while units with a capacity of 500,000 lb. per hour are also at work.

The modern tendency appears to be the development of still larger steam generating units, which will utilise to better advantage the space they occupy, and for still higher steam pressures to meet the more exacting demands of the steam cycles that are now becoming fashionable, sometimes at a gain in thermal efficiency, which is often more in evidence than the increased financial or commercial efficiency of the plant in which they are adopted.

While the height of furnace walls has increased both the pressure on them and the expansion of the refractories that has to be taken care of at furnace temperatures, the design of furnaces has also been rendered difficult by the use of hot air and of less excess air to secure the best combustion of the fuel.

The air heater is steadily coming into use in power stations, either as auxiliary to, or to supplement, economisers where the feed water is being heated by steam bled from the main turbines. In this use of hot air a compromise has often to be found between consequent repairs to mechanical stokers and refractories and a slightly lower efficiency in fuel combustion. The remedy is being found in water walls.

Steel economisers are costly, and if the feed water is made so hot by bled steam that the economiser can do but little good at a final gas temperature at which it will operate safely, the final gas temperature desired may be more safely secured by the use of an air heater, in which case the element of anxiety may be transferred from the upkeep of the economiser to that of the furnace.

The corrosion of steel economisers is being reduced by the greater attention paid to the quality of the feed water. Exterior corrosion, which is apt to occur at low final gas temperatures, is avoided by keeping away from the zone of low temperatures, and by the development of designs in which leakage of water into the gas space is avoided.

The capital cost of a generating plant, whether for steam only or for the production of electricity, may have a profound influence upon its commercial value; hence, the space it occupies is important, as this affects the size of the building it is housed in, and it follows that the less the space occupied and the more such space is utilised, the better.

The water-tube boiler occupying less ground space than cylindrical boilers, was an important advance, but the multiplicity of types of water-tube boilers has not led to such a great advance as has the adaptation of the various types of water walls and water screens to water-tube boilers.

The division of the duty according to the latest ideas is to arrange a large portion of the heating surface so that it may "see the fire."

Designs for the higher steam pressures have so far developed that boilers with a working pressure of 800 lb. per square inch are now being made without any rivets. The drums are hollow forged, and all joints are made by expanding. On the Continent welded drums are allowed, but in this country they have not yet been accepted, though how soon they may be is an open question. A short time ago the Board of Trade had passed no boilers working at a pressure exceeding 250 lb. per square inch, but now there are boilers with a pressure of 500 lb. per square inch on ships under their survey.

The question of turbulence is again receiving attention, and is being provided for by special types of burners for pulverised or liquid fuels, for which, it is claimed, smaller combustion spaces are effective.

With data available of more than fifty plants at present operating at steam pressures of 500 lb. per square inch and more, it may be said in conclusion that the use of higher steam pressures has not brought with it the troubles that were expected.

Commercial results are still anxiously awaited, but the prospects are distinctly improving.

Taking the boiler heating surface as 100, maximum figures for the other added surfaces are:—

	Per cent.
Superheaters	86
Economisers	150
Air heaters	700
Water walls	60

In the field of higher temperatures, a metal at a reasonable price is still awaited that will withstand the stresses at such temperatures. Ordinary cast steel has never been as good as could be desired under steam pressure, but greater care and skill in the foundry are leading to improvement, and forgings are in many places now taking the place of castings, with beneficial results.

Major S. J. Thompson questioned whether anyone could have summed up the subject of the paper better than the author had done. Mr. Patchell, he reminded the meeting, had been one of the pioneers in introducing the large-sized boiler into this country. The main question seemed to be whether we should use a large boiler or adopt a small boiler with a large number of accessories. It was very difficult to-day to sift the wheat from the chaff and all were anxiously awaiting the publication of results obtained by others, particularly by foreign engineers.

Mr. B. Samuels said that temperature and pressure were not the only factors which to-day influenced the boilermaker in his search for efficiency. He had to deal with the large number of auxiliaries with which a boiler might be fitted. Among such auxiliaries was the air heater. To-day air heaters giving a temperature of 340 deg. to 400 deg. Fah. were in use, and in

* No. I. appeared June 8th.

one instance a temperature as high as 500 deg. was reached. It was necessary, however, to tread warily with such high air temperatures, for they might induce a premature coking of the coal.

Mr. I. N. Hennan said that there was a decided tendency to-day to make that part of the boiler through which the water circulated naturally small and to heat it by radiation. It was very important to do everything possible to cut down the capital cost of boilers, for such cost was the bugbear of electricity generating station design.

Mr. T. Sugden remarked that the rapid development of boilers in recent years was caused, not so much by a search for increased efficiency, as by a desire for increased output. Speaking of the need for a trustworthy material to resist high temperatures and pressures, he commented upon the fact that it seemed difficult to obtain such a material which would at the same time possess the property of being readily expanded into headers. The present trend of boiler design was, he held, in the direction of the flash boiler. For example, in a boiler generating 100,000 lb. of steam per hour at 800 lb. pressure, the water would be out of sight in the gauge glass in less than three minutes if the pumps stopped and would all be gone inside twenty minutes. Engineers had a good deal yet to learn as to whether to employ increased pressure or temperature or both. He suggested that they might obtain all they desired by increasing the temperature without raising the pressure.

Mr. H. Sporburg said that increased pressure did not give all that was wanted, and it was undesirable that the boiler manufacturers should take the easiest road. Engineers desired higher temperatures, but it looked as if they could only get them by using very costly materials.

Mr. H. McKay expressed the view that welded seams for boiler drums would never be considered seriously in this country. The future, he held, lay with boilers of increased size and with a compromise between high temperatures and high pressures.

Mr. F. Samuelson said that, so far as the turbine was concerned, temperatures of 700 deg. to 800 deg. Fah. could be employed without trouble. He was prepared to build a turbine to operate at 1000 deg. Fah. as soon as the boilermakers could give him a boiler to produce steam at that temperature. He believed that better results could be obtained by raising the temperature than by raising the pressure.

Mr. S. B. Donkin said that the net result of modern boiler developments was to force engineers towards the use of powdered fuel. It was the task of the stoker manufacturers to produce a stoker that would withstand air temperatures up to 600 deg. Fah. If they could do so, would everyone not be much happier without the multitude of accessories required in a powdered fuel installation ?

Mr. W. H. Martin dealt with the manufacture of welded drums on the Continent and said that over 700 such drums were in use at the beginning of this year. They were being employed not only for high pressures—up to 860 lb.—but for ordinary pressures of about 200 lb. They were lap-welded on a machine which practically cut out the human element, and could be made up to 31ft. in length and 4ft. in diameter with but one weld. Above that size two welds were required. The strength of the weld was guaranteed to be at least 90 per cent. of the strength of the plate.

Mr. J. O. Twinberrow said that the steaming economiser mentioned by Mr. Patchell was a direct outcome of experiments described by Dr. Jacobus at the first World Power Conference. He held that the tendency in boiler design was towards the use of small furnaces and a high B.Th.U. liberation per cubic foot of furnace volume.

Mr. Patchell, in the course of a brief reply to the discussion, said that, although the heating surfaces of boilers were becoming bigger, the boilers themselves were becoming smaller. Boilermakers in their own defence were being forced to take up the supply of accessories, such as water walls, economisers, and air heaters. In the United States there was far less difference between boiler test efficiencies and the ordinary efficiencies realised in day-to-day running than there was in this country, although we were improving in that respect. There were, in his opinion, too many frills and gadgets about the modern boiler. For himself, he desired no more buttons on his coat than would suffice to keep the wind out.

AT THE SURVEYORS' INSTITUTION.

On Tuesday morning, with Dr. S. L. Pearce in the chair, the following paper was taken :—

ELECTRIC TRANSMISSION OF POWER AS APPLIED TO LARGE AREAS.

By ARCHIBALD PAGE, M. Inst. C.E.

A consideration of the subject of electric power supply to large areas shows immediately that there are two questions of primary importance, namely, (1) the definition of " large area," and (2) the sources from which its supply of electricity will be derived, and the location of such sources in relation to the area.

It has become customary to classify the transmission system for supplying power to such an area into main and secondary transmission. The former has two functions, namely, (1) long-distance transmission of power in one direction, and (2) interconnection of important power stations and districts—an outstanding example of which is " the grid " in this country.

The ideal to be aimed at in designing a transmission system is to make electricity available without restriction throughout the country. The system chosen must therefore provide for infinite expansion in the most flexible manner possible, the charges to the consumer and the reliability of supply being the real criteria.

So far as the main transmission system is concerned there is no alternative to overhead lines, and the natural characteristics of a country are the predominating factor in determining the general arrangement.

The three-phase 50-cycle system has much to commend it as a standard transmission system. Unfortunately, it is by no means the only one in use, and the policy of standardisation of frequency, whilst sound in itself, introduces considerable complications, both financial and technical.

The voltage and carrying capacity of the grid lines have been fixed at 132 kV and 50,000 kW. These were found to give the best balance of advantages on the economic side, and as it may be necessary to use cable on certain sections, there were serious technical disadvantages in increasing the voltage above the figure chosen. In passing, it may be of interest to state that quite a considerable length of cable is in operation at this voltage in New York and Chicago. It is, of course, of very special design and construction and consists of three single cables employed as a three-phase unit.

Experience with the first scheme has shown that the total cost of construction will be approximately equally divided between the lines, the transformers, and the switchgear.

The circuit breakers will have a rupturing capacity of 1·5 million kVA, but, although the number used in each sub-station and grid point—which are all of the outdoor type—will be minimised, the cost of tapping the main lines is still such that this will not be done for loads below 10,000 kW.

The general design of the lines follows established practice, and lattice steel towers have been preferred to those of reinforced concrete.

The conductors will be of steel-cored aluminium with a diameter of 0·77in. The corona voltage is 180 kV to earth, whereas the actual pressure to earth is 77 kV, so that, despite the published statements to the contrary, there will be little danger of luminosity, even under the most adverse weather conditions. The average span will be 900ft. and the suspension insulators will be of the cap-and-pin type, nine to the string, this number having been decided upon after a careful study of the effect of foggy salt-laden atmosphere. The high insulation strength thus obtained, combined with the use of highly conducting and properly grounded earth wires, will form the chief safeguard against lightning.

The stability of the grid system is intimately connected with the problem of voltage control. Control will be obtained by " on-load " tappings on the transformers, and the object is to operate the lines at or near unity power factor, some of the alternators at selected stations acting as rotary condensers. The lengths of individual line units do not exceed 40 to 50 miles, which renders the problem comparatively easy.

Under the head of secondary transmission there is not much of special interest to record. Pressures range from 11,000 volts up to 66,000 volts, and it may be well to remark that the subdivisions referred to earlier do not mean duplication in any sense.

Underground cables will, as hitherto, continue to be extensively used.

This note would be incomplete without a reference to the regulations governing the erection of overhead lines and the multiple earthing of systems. It is recognised by the authorities and the industry alike that the old order of things requires to be changed, and as a result the cost of such lines is likely to be considerably reduced in future without adverse effect from the point of view of the safety of the public.

In opening the discussion, Sir John Snell remarked that he was really responsible for the proposal to adopt 132,000 volts for the interconnecting lines of the national power scheme. The author was right in differentiating between the two classes of transmission—primary and secondary. The primary lines would serve for interconnecting the power stations and would result in a considerable reduction in the amount of spare plant and improvement in the load factor. The distance the lines would have to run would not be great ; in most cases the length of the individual line units would not exceed 50 miles. The capacity of the lines would be 50,000 kilowatts. Longer lines would no doubt be erected, especially when it came to developing more water power in the country. Lines were being laid out on the ring system, so that there would be alternative routes. The whole point of the 1926 Act was that money would be better invested in a well-designed transmission system than in spare plant, and incidentally the country would be better served. He thought that the new regulations governing the erection of overhead lines would be a great help.

Mr. F. H. Clough said that the author had made a short reference to the use of rotary condensers, and he thought that, in working out any portion of the grid system, advantage should be taken of synchronous machines at the point of power distribution in order to improve the power factor and ensure good voltage control. The capacity current of 50 miles of 132,000-volt line amounted to about 8 per cent. of its normal load of 50,000 kVA, and was about equal to the magnetising current of the step-up and step-down transformers. With a high-voltage " grip," interposed between the points of generation and distribution, there would be reactance of the transformers, in addition to the load reactance. That might considerably reduce the power factor and increase the size of the generators and transformers. The main generators could always be run at slightly lagging power factor, and if the quadrature current was not too large, it might be supplied by the main generators. Beyond a point, however, it would be economical to install synchronous machinery at the distribution points and very materially reduce the necessity for taps or other regulating devices on transformers, which could be made smaller on account of the better power factor.

Mr. R. O. Kapp pointed out that the interconnecting lines of the national power scheme would only have to carry about 20 per cent. of the peak load output, and that would have a considerable influence on the scheme. The loss would be very small. A more important question was that of regulation, which, however, was not a serious matter. Half the drop would be due to the transformers and half to the lines. As the load grew there would be less interchange of energy. The question of dealing with the wattless current, as raised by Mr. Clough, was important, as all stations would try to pass the wattless current on to other stations.

Dr. Lieb, an American engineer, remarked that experiences in the United States were no criterion as to what should be done in this country. Many of the ideas prevalent in America would not be applicable to England, and *vice versâ*. Interconnection had gone so far in America that one-third of the United States had been tied together, and operated as a single system. While coal remained at its present price —and there did not seem to be much prospect of its price increasing—water power would be developed with greater reluctance than hitherto. Underground 132,000-volt cables had been in service in New York and Chicago for six months, and they had operated satisfactorily. The possibility of using cables for such high voltages was a matter of considerable importance because the current from high-pressure overhead lines could be taken through cities without having to reduce the pressure by means of transformers. Stations had to be interconnected in a manner that would allow of a considerable flow of energy between the plants in order to take advantage of the diversity factor. Experience in America showed that it was essential to place interconnected power stations in the hands of a load dispatcher, who had supreme command, and decided which stations should carry the load.

Dr. Ferranti said that he had long felt that one of the great troubles associated with large power schemes was the uncertainty of switchgear. Gas distribution was very simple indeed ; the supply of large quantities of gas could be interrupted by means of simple valves, but not so with electricity. What was required was a more simple switching system—something that would easily cut off the supply when things went wrong. The fact that it had been stated that it would not pay to tap 132,000-volt lines for less than 10,000 kilowatts indicated that the position was scarcely satisfactory. If current could be handled more cheaply and easily it would be a great advantage.

Mr. C. D. Taite remarked that it was very difficult to get a system of protection that would work satisfactorily under all conditions. The transmission lines would work under light load and full load conditions. At full-load there would be plenty of plant to burn out faults or open switches, but at light loads the circuit breakers might not act. Only a small part of the total current went into the transmission lines.

Mr. Alexander Dow (President of the American Society of Mechanical Engineers) said that if plant was thrown off a system a certain part of the load should be thrown off as well. High voltages with steep wave fronts were not suppressed by transformers. Voltages of that nature were at very high frequency, and, as predicted by Dr. Steinmetz, and as practice had demonstrated, they were not reduced by the transformers and were passed on to the secondary system. He did not think that English engineers had anything to learn from American engineers.

Replying, Mr. Page said that the discussion had centred mainly on the reasons for doing things. In selecting a pressure of 132,000 volts for the interconnecting lines, Sir John Snell had made a wise choice, and in all probability he had had the 132,000-volt cables in mind. The new regulations governing the erection of overhead lines were a great help and the absence of guards was very beneficial. No doubt the amount of spare plant would be enormously reduced in future. Referring to Mr. Clough's remarks, Mr. Page said that synchronous condensers at every grid point would be a very serious disadvantage. The point raised by Dr. Ferranti was important. Possibly the younger generation would show that large electrical systems could be controlled without opening switches at all. Mr. Taite apparently thought that it was proposed to tie up the grid solidly, and that if anything happened, the whole system would go down. That, however, was not the case. The part of the system where the trouble arose would be cut out instantly.

IN THE GREAT HALL OF THE INSTITUTION.

Sir John Purser Griffith presided on Thursday during the joint discussion of the two notes which follow.

THE DIMENSIONS OF HARBOUR AND DOCK APPROACHES.

By Sir CYRIL REGINALD SUTTON KIRKPATRICK, M. Inst. C.E.

It appears that present needs are satisfied by ships drawing up to 33ft. of water. During 1927, when the limit of draught permitted in the Suez Canal was 32ft., only one ship of 32ft. draught and only nine ships of between 31ft. and 32ft. draught used the canal. When the 1921 programme of the Suez Canal Company is completed, there will be a depth of 42ft. 8in., permitting the passage of a ship of 36ft. draught. The Suez Canal has long been considered an obstacle to an increase of draught for ships intended to ply between Europe and the East, but this is no longer the case, nor will it be so in the future. The Suez Canal will thus be equal in this respect to the Panama Canal, which, with its locks, is not capable of being easily deepened. It is reasonable to suppose that the size of the locks of the Panama Canal will limit the size of future ships, except those on the specialised Transatlantic routes. These locks have a usable length of 1000ft., a width of 110ft., and a depth of 40ft., so that a vessel approximately 950ft. long, 105ft. beam and 36ft. draught could use both canals.

It would appear therefore that for the next few years a draught of 33ft. will be sufficient for all except specialised Transatlantic routes, and it is probable that this dimension will gradually be increased to a maximum of 36ft.

On the Transatlantic routes there is already a vessel, the

ss. "Leviathan," which, when fully loaded, including bunkers, has a draught of 41ft. It is generally considered that both the dimensions of vessels of the largest class and the number of such vessels engaged on these routes will increase, and the author has no reason to modify the view expressed in his report to the thirteenth International Navigation Congress—1923—that locks designed to take such vessels should be constructed 1150ft. long, 130ft. wide and 45ft. deep on the sill.

The depth of locks and approach channels depend on the physical conditions of the particular port and require very careful study. For example, where the tidal range is small, as at New York, it is practicable to give sufficient depth of water for vessels of deep draught to enter at all states of the tide. On the Mersey, however, where the tidal range is much wider, deep-draught vessels are mainly docked during the upper half of the tide. At the South Wales ports, owing to the wide range of tide, the period for docking is still more limited than at Liverpool.

A clearance over the dock sill of 2ft. under the keel is usually sufficient, but a wider margin must be provided in approaching channels.

In open waters there is the range of the waves producing vertical movement of the ship known as "scend." The maximum will vary at each port according to the degree of exposure to wave action.

The sinking of the vessel, known as "squat," must also be taken into consideration in reference to the depth of approach channels. This dimensions varies with the speed depth of water, and lines of the ship. Mr. H. N Babcock gave as a rough approximation that the squat of a ship when near the bottom, in feet, may be about one-fifth of her speed in statute miles per hour. But from observations made upon the ss. "Mauretania," he stated that at a speed of about 18 miles per hour the squat was about 4·65ft. at a place where there would have been about 15ft. of water under her keel if she had been stationary. The late Mr. Quellennec estimated that in the Suez Canal the keel was lowered 1ft. 4in. to 1ft. 8in. at a speed of about 6¼ miles per hour, and 3ft. 1in. when the speed was increased to about 9½ miles per hour. The author knows of no formula which will give accurately the allowance that should be made for squat, but he believes that experiments are being carried out in this respect.

HARBOUR BREAKWATERS.

By HUGH HENRY GORDON MITCHELL, M. Inst. C.E.

Broadly speaking, there are only two classes of breakwaters, those whose stability depends partly on their mass and partly on breaking up the force of the waves by the configuration of their exposed faces, and those that depend entirely on their mass to resist the waves.

For the purposes of this discussion, breakwaters may be divided into three types:—(1) Mound breakwaters, (2) mounds with solid superstructures, and (3) solid breakwaters. For a general discussion of different types of breakwaters it has been assumed that all the materials are equally economically available.

(1) *Mound Breakwaters.*—The great drawback to mound breakwaters, especially when they are constructed with a large quantity of small stone, is that they require constant replenishing. Comparison of various types of mounds appear to indicate that, though comparatively small stones may be used near the base of a mound when the water is deep enough to avoid disturbance, larger stones should be used as the mound is raised, and the top should be covered with the heaviest stone available.

The mound type would appear to be particularly suitable where the bottom consists of a considerable depth of soft material, as the weight of the breakwater is distributed over a wide base. Where the bottom is soft mud, there is likely to be a considerable sinkage of the stone into the bottom, accompanied sometimes by slips and spuing up of the mud at the toe of the bank. It is a question for consideration in such cases whether the breakwater should be deposited on some form of mattress, or alternatively, whether a trench should be dredged in the mud and filled with sand or good earth to form a bed on which to deposit the rubble mound.

(2) *Rubble Mounds with Solid Superstructure.*—This is a common type of breakwater. There are various forms of superstructure. A usual form is the sloping bond type, where each slice of blockwork is free to settle independently of the adjacent slices, being held laterally to the adjacent slices by keys or joggles running from the top to the bottom of the work. Blocks weighing up to 30 or 40 tons are used for such work, usually set over-end by a Titan crane, whose weight on top of the structure causes it to settle, and helps to consolidate the underlying rubble mound. The blockwork is capped with mass concrete after settlement has ceased. Sometimes coursed blockwork is used, but the author suggests that slice blockwork is better. Another method is to use blocks weighing as much as 300 or 400 tons each, set in place by floating cranes, or caissons floated out and sunk on a prepared bed on the mound and subsequently filled.

However the superstructure may be formed, there is always the risk that the seaward foundation may be scoured out by the downward force of the waves after striking the face of the work, unless the foundation is adequately protected. An adequate protection is a wave breaker of large 30 or 40-ton blocks dropped pell mell on the seaward face of such work.

(3) *Solid Breakwaters.*—Formerly, it was a frequent practice to build two facing walls connected by cross walls with rubble filling in the cavities, the whole capped with masswork. Later, in breakwaters of this type, the rubble filling was omitted, and the work was built solidly of blocks bonded and keyed together throughout the whole cross section—for example, the breakwaters at Dover and the north breakwater at Peterhead. There is a limiting depth of water in which blocks can be set economically by divers. About 70ft. might be considered as a practical limit.

Summing up, the author suggests that mound breakwaters are the most suitable where stone is plentiful and the sea bed is soft and shallow, say, not more than 8 or 10 fathoms. Mounds with solid superstructure are suitable where there is a great depth of water, or where the bottom is sand or other fairly firm material. They have an advantage over the simple mound type, in that the vertical harbour face can be used as a quay. All breakwaters of this type require protection by wave-breaker blocks on the seaward face. Both the above-mentioned types are liable to involve heavy maintenance charges.

The solid breakwater is the most suitable type where a rock or other hard foundation is available, and where the working depth of water is not more than, say, 12 fathoms. Solid breakwaters have the advantage of requiring a minimum of material and upkeep, and the harbour face can be used as a quay.

Mr. H. A. Reed, in opening the discussion, referred to Sir Cyril's remarks on the depression in the water of a vessel under weigh, known as "squat," and mentioned recent experiments made in the Suez Canal and in the Manchester Ship Canal. It had been found that the maximum "squat" experienced in the former was just under 1 m. On the Manchester Canal, where the cross section of the waterway was smaller and the ship's speed less than in the Suez experiments, a squat of 1ft. 9in. aft and 1ft. 6in. forward had been observed in the case of a vessel moving at 6 knots and having an immersed cross section of one-quarter the wetted cross section of the canal. The amount of squat seemed to vary somewhat with the form of the hull and to be more forward than aft in some vessels and *vice versâ* in others. It was difficult to evolve any formula which would be applicable to varying speeds and other conditions, but he had hopes that further experiments would result in some satisfactory and generally applicable rules from which the amount of squat could be deduced. The speaker also called attention to the effect of the degree of salinity on the draught of vessels.

Mr. L. H. Savile referred to the rule which he had ventured to enunciate in a paper he had contributed to the International Navigation Congress in London in 1923, namely, that the cost of constructing port works in general showed an increase approximately proportional to the ratios of the cubes of the draughts of the largest ships for which they are designed. He considered that if shipowners could see their way to check the increase in the draught of the largest classes of vessels they would benefit in the long run, for there was no doubt that they had to pay in the form of harbour and dock dues for every increment in the available depth provided at ports and that a reduction of dues would follow on a cessation in the increase of maximum draught.

Sir Ernest Moir referred to several breakwaters constructed in recent years by his firm, and briefly described the Valparaiso breakwater which is now being extended across the bay in water almost everywhere 175ft. deep. He was specially interested in the question of the depth of water at which destructive wave action ceased. In situations such as those in which breakwaters had been built on the Pacific coast of South America he would have liked to stop the raising of the mound, on which a solid vertical superstructure was to be founded, at a depth greater than 40ft., which was the depth adopted by the Chilian engineers at Valparaiso. He regarded that breakwater as the most daring structure of its kind yet built. The mound was largely composed of sand. In the extension work they were using 60-ton sloping blocks for the superstructure wall instead of the monolithic caissons adopted for the inner portion of the breakwater. Sir Ernest also referred to the breakwaters constructed by his firm at Seaham Harbour some years ago, where solid coursed block work had been founded on soft limestone rock. He mentioned that case as showing the absolute necessity of constructing a good apron of blocks as large as possible when a foundation was in the slightest degree liable to erosion. At Seaham two large cavities, each 70ft. long, had been scoured in the limestone under the breakwaters, each forming a passage or tunnel extending completely through the structure. The soundness of the work in the block work superstructure was evidenced by the fact that those huge cavities were bridged by the blocks above them and the blocks had not been displaced.

Signor Cagli (Venice) said there were two or three points in Mr. Mitchell's paper with which he could not altogether agree. He considered that the ideal alignment for the outer cant or arm of a breakwater in deep water was to place it at right angles to the direction of the heaviest seas. Secondly, his conception of the ideal breakwater in such conditions was a vertical wall founded at such a depth that the rubble mound or sea bed on which it was placed would be immune from all liability to scour or wave action. He instanced the great breakwaters at Genoa. The old Galliera breakwater, a very fine and massive example of the mixed type breakwater with a pell-mell wave breaker on its seaward face brought up to above water level, was 40 m. in width at sea level. It had sustained very considerable damage on many occasions over a long period of years and was usually damaged to some extent by every heavy storm. On the other hand, the new breakwater at Genoa, now known as the Principe Umberto, but formerly as the Victor Emanuele III. breakwater, was of the vertical wall type, the wall being founded on a rubble mound about 35ft. below water level in depths of water up to about 60ft. That wall was only 12 m. wide at water level and, since its construction twelve years ago, it had sustained no material damage, although it had been exposed to several exceptional storms. The Italian engineers responsible for breakwater work, with the knowledge they now possessed, would have preferred to have founded the vertical wall at Genoa, and others commenced about the same time, in a greater depth than 35ft., and, in fact, they had already adopted for all new works at Genoa and in other situations of equivalent exposure a depth to the upper surface of the rubble mound of 40ft. or more. All breakwaters now being built in Italian harbours had at least that depth of vertical wall.

Mr. T. M. Newell said that, whether a port was to be treated as one accessible at high water only or as a deep-water port at all states of the tide, depended mainly on the rise and fall of the tide. Liverpool, with a rise of tide of 27ft. at ordinary springs, had quite recently been converted by the construction of the Gladstone Dock entrance, from what was a high-water port, so far as the docks were concerned, into one giving access to practically all vessels for eight hours every tide; that is, from four hours before to four hours after high water. He thought Sir Cyril Kirkpatrick had not fully stated the case when he confined his statistics of draught to the twenty largest ships. In fact, there were many ships leaving the port of Liverpool of much less than 10,000 tons measurement with draughts of from 30ft. to 34ft. Such ships, and there was already a considerable number of them, engaged in the eastern trade, loaded down to the maximum draught which they could carry through the Suez Canal. That is, they left Liverpool with a draught too great for the canal, but which was reduced sufficiently by the time they arrived at Port Said to pass through the canal. The Mersey Docks and Harbour Board had just completed a new dock entrance at Birkenhead which was intended mainly for shipping in the eastern trade. Such ships would now be able to load deeper than ever before. It was not a case of the Suez Canal being in advance of the draught of vessels, but rather of existing vessels being unable to load to their full capacity pending the completion of the deepening programme of the canal. He thought that the requirements of shipowners in regard to draught were likely to increase faster than the canal could be deepened and that Liverpool would take full advantage of every foot of additional depth the Suez Canal authorities could give.

Mr. H. R. Moffatt described the extension of the Table Bay breakwater which is now being carried out. He said that sloped block work had been adopted for the breakwater wall which was founded directly on the hard clay of the sea bed in a dredged trench.

Mr. Brysson Cunningham made the suggestion that Lloyd's Register should contain particulars of the maximum loaded draught of vessels.

Mr. N. G. Gedye said he would like to supplement Signor Cagli's remarks by a reference to the system of constructing vertical wall breakwaters of very large concrete blocks. That system had been developed in Italy and had recently been adopted by some French engineers. French engineers had adopted Cyclopean blocks, weighing about 420 tons, for the building of the Mustapha breakwater at Algiers. That was an interesting departure, on the part of French harbour engineers, from the type of breakwater constructed in deep water which they had favoured in the recent past and of which such splendid examples existed at Marseilles and many other ports. He referred to the deep rubble mound brought up to water level and protected by pell-mell concrete blocks. It had recently been decided to abandon that classic form of breakwater construction in the case of the new breakwaters for the Bassin du Phare to be built at Marseilles in depths of from 95ft. to 110ft. and to build them with vertical walls of solid Cyclopean blocks founded on a rubble mound at 49ft. below water level. Those blocks would weigh 500 tons; they were to be handled by floating cranes and set one above another four tiers high so as to form piers free to settle on the mound independently.

Mr. Foster King, Mr. Delap and Commander Tuffill also joined in the discussion, to which Sir Cyril Kirkpatrick and Mr. M. F.-G. Wilson—on behalf of Mr. Mitchell, who was not present—briefly replied. Sir Cyril pointed out that although the official maximum draught in the Suez Canal to-day was 32ft., vessels drawing 33ft. could pass through it, and in special circumstances did so. When the present programme of deepening was completed vessels drawing 36ft. would be able to navigate the canal. Mr. Wilson emphasised the destructive effect of waves even at great depths, and instanced the dragging out of a 50-ton block from a solid apron laid along the face of the breakwater at Peterhead in a depth of 40ft. to 50ft.

The two following papers were then discussed.

MODERN ROAD AND BRIDGE CONSTRUCTION.

By FREDERICK CHARLES COOK, M. Inst. C.E.

The foundation is that part of a road with which it is least justifiable to take risks, and it should be designed with due regard to the bearing capacity of the subsoil upon which it is to be placed. Theoretically the character of the foundation should be determined by the intensity of the point load; but other factors must be taken into account; for example, both the axle load and speed of vehicles tend to increase, while the allowance to be made for impact is still a matter of investigation.

There are advantages in a pitched foundation. It possesses a certain resilience, facilitates drainage, and can be readily relaid. It is unwise to generalise; but it can perhaps be accepted that a pitched foundation is adequate where traffic considerations do not demand a more lasting surface than tarmacadam. In such cases cost should be the deciding factor. Steel reinforcement serves a useful purpose where cement concrete is used, in the direction of both elasticity and stresses, and it should be regarded as a necessity where the substratum is unsuitable. Double reinforcement is desirable where the subsoil is known to be unstable—as where the road is much trenched.

In the choice of surfacing material attention should be directed to the heaviest unit weight of the vehicles regularly using the road. The surface may wear well under traffic which is heavy in the aggregate, but which comprises mainly light vehicles, whilst it will quickly disintegrate as the result of damage done by vehicles few in number but heavy in weight; for example, under a motor omnibus service or in the neighbourhood of milk or sugar beet factories. In these days of rubber-tired vehicles it is doubtful if anything is gained by the use of granite setts, except on steep gradients or where there is a large proportion of horse-drawn steel-tired vehicles.

The improvement of road surfaces in this country has developed from water-bound macadam, grouted macadam, and tarred macadam to more lasting materials, such as asphalt wood blocks and granite setts, in the earlier stages one forming the foundation of the other. Thus tar, bitumen, and asphalt are specially serviceable in the economical adaptation of old roads to modern needs.

For similar reasons it may be held that cement concrete as a surfacing material is less adapted to reconstruction than to entirely new work—as in a by-pass road—where no inconvenience is caused by delay due to curing, and where the disadvantage of a longitudinal central joint can be avoided. From a traffic point of view there is an advantage in forming expansion joints at an angle of, say, 60 deg., while freedom of action in the subsequent choice of a surfacing material is ensured by providing a sufficiently deep kerb in the initial stage of construction.

Non-slipperiness is an essential quality in a surfacing material.

Complaints as to slipperiness chiefly arise in connection with asphalt, and the remedy is largely in the hands of the manufacturers. It is probably true that the chief cause of skidding is bad driving—the application of the brakes in changing direction is one of the principal causes—but public opinion blames the road, and it is worth while seeking a remedy even at the expense of some life of the material. It may be worth while considering whether the term of maintenance placed upon asphalt manufacturers is not sometimes so excessive as to lead to the exclusion of all factors other than the life of the pavement. A similar tendency can be observed in the case of solid rubber tires, with the result that density and not resilience is the chief quality aimed at—to the detriment of the road.

Surface dressing now represents a very large part of main road expenditure. It has the merit of rendering the road non-slippery where suitable chippings are used, but it is troublesome in application, both to Highway Authorities and to road users. Where an annual surface dressing is necessary the present cost, on a ten-year basis, is approximately 2s. 4d. per square yard, and it thus becomes a question whether a corresponding initial expenditure should not be incurred in order to secure a more lasting surfacing material. In particular, the periodical surface treatment of a homogeneous material such as cement concrete seems to be both a negation of the original effort and economically unjustifiable.

THE PROBLEM OF ROAD TRAFFIC FROM THE ENGINEERING POINT OF VIEW.

By HERBERT RAIKES HEPWORTH, Assoc. M. Inst. C.E.

The necessity of viewing the highway engineering problem from the traffic standpoint was realised 120 years ago, as is shown by the Report, dated 1808, of a Committee appointed by Parliament to consider and report upon the highways of the kingdom. The nature of the problem has been changed in recent years by the introduction of mechanical transport, and it has become acute. Traffic censuses were taken on the principal roads throughout the country in 1922 and in 1925, and the policy of the Ministry of Transport is to take such a census at intervals of three years. Unfortunately, the results are not published in a form which makes them of use and real interest to the public, but the result of the third series should furnish valuable data to guide future policy.

Traffic figures taken at 206 points in the West Riding of Yorkshire in 1922 and in 1925 show :—

(1) An increase of 59·40 per cent. in the average number of vehicles per day.

(2) An increase of 68·06 per cent. in the average tonnage per day.

(3) A maximum increase of 392·16 per cent. in tonnage per day at one point (on the main road between Harrogate and Ripon).

(4) A reduction from 9·17 to 4·14 per cent. in the average number of horse-drawn vehicles per day.

(5) A reduction from 4·05 to 3 per cent. in the average tonnage of horse-drawn traffic.

The decrease in horse-drawn traffic has led—among other things—to a higher speed of traffic, with, paradoxically, more congestion at "bottle necks" and in urban areas.

The traffic censuses also show clearly that throughout the length of a given road there is a marked rise in the volume of traffic near the urban areas, with a falling-off in the more rural portions, indicating that rigid standardisation of road width and construction is unnecessary.

It is very satisfactory that the tendency in the design of vehicles is sound and in the direction of economy. Recent designs embody a lowering of the centre of gravity and the use of pneumatic tires, not only in passenger vehicles, but also in the lighter types of goods vehicles. Other features include the use of six wheels—a means of distributing the load ; improvement in the springing of vehicles generally ; the adoption of four-wheel braking systems ; and increased efficiency of the engine and transmission.

The increasing average speeds of all classes of motor vehicles emphasise the retarding action of "bottle necks ;" make imperative the provision, on all the more important routes, of at least three-way carriageways ; and accentuate the need for improved visibility. Speed is an essential factor also in determining the form of construction of the carriageway.

Road warnings or instructions have considerable influence upon the rapidity with which traffic can be dealt with at danger points and congested places, and not only should the erection of signs be done with due regard to the lay-out of the road, but the signs should be such as to command immediate attention and response on the part of the driver.

Uniformity in signs is essential, and in the cases of large towns there is a need of a system of bold directions for through routes and for the alternative or by-pass routes.

The development of road traffic, particularly passenger traffic, has been so rapid that all factors in the problem have not yet received due consideration. An obvious need in the case of established services is the provision of central or terminal assembly points in positions where interference with the ordinary flow of traffic is avoided, and in a manner providing for the comfort of waiting passengers. A large station on these lines has recently been established in London, and there is no doubt that an extension of such facilities will become compulsory.

More systematic treatment of the problem of "parking places" for private motorists is long overdue, not only in towns, but also wherever pleasure motorists congregate.

IN THE THEATRE OF THE INSTITUTION.

Sir Hugh Reid presided, when the following note was submitted for discussion on Thursday, June 7th ;

LATEST TYPES OF STEAM AND INTERNAL COMBUSTION LOCOMOTIVES.

By Sir HENRY FOWLER, K.B.E., and HERBERT NIGEL GRESLEY, MM. Inst. C.E.

The most recent British practice as regards express passenger locomotives and powerful goods locomotive is given in Table I. The passenger engines are characterised by high boiler pressure and valve gear designed to allow a high ratio of expansion.

The four express passenger engines enumerated differ in many essential features. The Great Western Railway engine has four cylinders with cranks at 180 deg., giving four exhaust beats per revolution, and it is fitted with a high-pressure boiler with a narrow fire-box. The Southern Railway engine is fitted with four cylinders with cranks at 135 deg., giving eight exhaust beats per revolution, and it is fitted with a narrow fire-box. The other two passenger engines have each three cylinders with cranks at 120 deg., giving six exhaust beats per revolution. The London, Midland and Scottish Railway engine has a narrow fire-box ; the London and North-Eastern Railway engine is fitted with a larger boiler having a wide fire-box. All the engines are fitted with superheaters, those on the L.M.S., Southern, and L.N.E. engines giving a high superheat.

Apart from these engines of orthodox construction, the following engines are worthy of mention :—

(1) Experimental engine No. 60,000, built by the Baldwin Locomotive Company, has a modified Brotan boiler, the fire-box sides being formed of water tubes while the barrel is of orthodox construction. The working pressure is 350 lb. per square inch. The engine is a three-cylinder compound having one high-pressure cylinder between the frames and two low-pressure cylinders outside the frames.

(2) The Schmidt-Henschel high-pressure locomotive has a fire-box composed of water tubes, containing distilled water, forming a closed circuit. The steam in these tubes heats water in a chamber carried over the fire-box and is thereby condensed and returned to the tubes forming the fire-box sides. The pressure in these tubes is 1100 lb. to 1300 lb. per square inch and the chamber over the fire-box, which is fed with water from the low-pressure portion of the boiler, generates steam at a pressure of 853 lb. per square inch, while there is a barrel of orthodox construction pressed to 200 lb. per square inch. Steam from the high-pressure portion of the boiler is superheated and utilised in one high-pressure cylinder, the exhaust from which combined with superheated steam from the low-pressure portion of the boiler is used in two low-pressure cylinders placed outside the frames.

(3) The Winterthur high-pressure locomotive, which is under trial on the Swiss State Railways, has a boiler of a special water-tube type. The high-speed uniflow engine has cam-operated poppet valves, a reduction gear of 1 to 2·5 being provided, with a jack shaft and connecting-rods transmitting power to the coupled wheels. The boiler pressure is 850 lb. per square inch.

Steam Turbine Locomotives.—The first turbine locomotive with electrical transmission was built in Glasgow in 1904. Recently, four geared turbine locomotives have been built, each of which embodies distinctive features in design. A brief summary of these follows :—

(1) In the North British Locomotive Company's turbine locomotive, exhibited at the Wembley Exhibition, the driving gear is arranged longitudinally and centrally on the locomotive.

(2) In the Swedish Ljungström locomotive the turbine is placed transversely on the framing and drives through gearing one of the axles and by coupling-rods to the other driving axles.

(3) The other two locomotives are of Swiss and German construction. In both of these the turbine is placed transversely and drives, through gearing, a lay or jack shaft which communicates the drive through a crank to coupling-rods between the driving axles.

Diesel Locomotives.—A considerable amount of experimental work has now been carried out on Diesel locomotives. This type of engine is a constant-torque prime mover, incapable of starting under load. The problem of its application to locomotive traction lies chiefly in an efficient method of transmitting the power from the engine to the wheels under the variable conditions demanded in railway practice. The types of transmission gears which have been applied include mechanical, electrical, steam, hydraulic, and compressed air.

The high first cost of the Diesel locomotive as compared with the low cost of the steam locomotive has, so far, been a serious deterrent to its application to railway service, the cost of the engine alone amounting to more than that of a steam locomotive of equal power.

Kitson-Still Locomotive.—This locomotive represents the most recent innovation in locomotive practice, and is the application to locomotive purposes of the "Still" engine, primarily developed for marine practice. The engine uses steam when starting or in emergency and normally runs as a Diesel locomotive. In this way the starting difficulty inherent in the Diesel engine is overcome.

TABLE I.

Railway.	Class.	Type.	No. of cylinders	Boiler pressure	Total heating surface, including superheater	Grate area.	Tractive effort.	Total weight of engine and tender.
				lb./sq. in	Sq. feet.	Sq. feet.	lb.	Tons cwt. qr.
Passenger—								
G.W. ..	"King George V." (No. 6,000)	4-6-0	4	250	2,514	34·3	40,300	135 14 0
L.N.E. ..	"Enterprise" (No. 4,480) ..	4-6-2	3	220	3,442·5	41·25	36,465	152 11 0
L.M.S. ..	"Royal Scot" (No. 6,100) ..	4-6-0	3	250	2,526	31·2	33,150	127 12 0
S.	"Lord Nelson" (No. 850) ..	4-6-0	4	220	2,365	33	33,500	140 4 0
Freight—								
L.N.E. ..	"Mikado"	2-8-2	3	180	3,455	41·25	38,500 (booster 8,500)	151 8 0
L.N.E. ..	"Garratt"	2-8-0—0-8-2	6	180	3,518	56·5	72,940	178 0 3
L.M.S. ..	"Garratt"	2-6-0—0-6-2	4	190	2,637	44·5	45,620	148 15 0

Sir John Aspinall, after paying a tribute to the private locomotive building firms in this country who had experimented with different types of locomotive, said that it was extraordinary how little the ordinary steam locomotives cost, how long they lasted and how well they did their work, and he suggested that the firms which were experimenting would be hard put to it to produce other types of locomotive which would be as economical from the point of view of wear and tear, and as cheap in first cost, as was the ordinary steam locomotive. That, however, was no reason why the experiments should not be continued. With regard to the booster, Sir John said that in a French publication he had read an account of a kind of booster which was invented by Monsieur Fremont in 1852.

Mr. A. E. Chorlton said that if the steam locomotive were going to work with single-expansion and very high pressure, surely there was going to be real difficulty in using piston valves, although he did not suggest that he was disappointed to find no mention in the paper of special valve gears for working with the expansions necessary with high pressures. The basic reason for the economy of the internal combustion locomotive was that its thermal efficiency might be six or eight times that of the steam locomotive, and, when allowance was made for the relative cost of fuels, a 30 to 50 per cent. fuel economy resulted. Furthermore, the internal combustion locomotive enabled one to halve the cost of labour because there was no stoking to be done, and it provided the possibility of coupling two or three units together in order to haul the largest trains with a single crew. Another attribute was that it was available quickly at all times. He agreed that the first cost was high, but it could only come down as the demand increased, so that the manufacturers had an opportunity to build more.

Dr. Brown (Swiss Locomotive and Machine Works) said it was the opinion of his firm that the steam locomotive could be improved to its utmost efficiency only by introducing high-pressure steam, or Diesel engines could be adopted as prime movers, because those engines, in principle, had the highest thermal efficiency. In building the Winterthur high-pressure steam locomotive, having a pressure of 850 lb. per square inch and working at a temperature of about 750 deg. Fah., the leading object had been to create a locomotive of the greatest simplicity and ease of handling, and for that reason it was not equipped with a condenser. Trials made on the Swiss Federal Railways, making use of the dynamometer car, had shown that the locomotive effected a saving of about 40 per cent. in coal and 50 per cent. in water, as compared with a standard steam superheated locomotive of equal power. It would be put into commercial service on the Swiss railways shortly. For internal combustion locomotives he thought that high-speed solid injection oil engines, working on the four-cycle principle, and at between 500 and 1000 revolutions, were best. The transmission gear should be so constructed that it did not involve too great a weight and high first cost of the whole locomotive. The electrical transmission gear was reliable, and could be adopted for all sizes of locomotive. The internal combustion locomotive was particularly applicable in countries where long haulage of coal was necessary, and where water was of bad quality or difficult to obtain.

Mr. Thomas Clarkson gave some particulars of his thimble waste heat boiler as used on internal combustion locomotives on the Canadian National Railways for heating the coaches.

Mr. Acland, commenting on Mr. Chorlton's remarks, said that the advantage of the internal combustion locomotive from the point of view of reducing the crew might or might not be very important, but the first question to consider was that of safety, and he doubted whether the Government would be likely to allow the railway companies to run a locomotive with only one man on board. One great advantage of the internal combustion locomotive—second only, perhaps, to its advantage in waterless countries where distances were very great—was that, intrinsically, it was a constant torque machine, which meant that it had constant, or practically constant, tractive effort, even at high speed, in contra-distinction to the steam locomotive, the tractive effort of which fell with the speed.

Mr. E. Cecil Poultney expressed the view that it would be very difficult indeed to improve commercially on the locomotive as it exists at present. The present type of locomotive was cheap to buy, and any type of locomotive, using steam, which was appreciably more economical in coal consumption was very expensive in first cost, which meant that a large amount of coal had to be saved in order to pay the additional interest on the increased capital outlay. Further, the ordinary type of locomotive could be made more efficient than at present by improvements in the valve gear for the distribution of steam, and the fitting of a feed-water heater, and those improvements could be effected at relatively small cost. The ordinary steam locomotive was built on very sound economic principles. The boiler was of the type which would produce the largest amount of steam in the smallest space and for the smallest expenditure of weight, and the method of arranging the engine was such that the mechanical friction—the amount of power absorbed in actually running the machinery—was the least possible. He believed the mechanical efficiency could safely be placed at from 85 to 90 per cent., and very frequently 95 per cent.

Mr. Niven, who emphasised that trade depression, the severe competition of road transport, heavy unemployment, and so on, made it imperative that there should be an intensive search for every means of reducing the cost of railway transport, said that the discovery of the most efficient type of locomotive involved research, and he urged that, in order that that research should be most rapidly fruitful in its results, there must be co-operation between the railways and the private locomotive building firms. He pleaded that the first step be made forthwith, and that the locomotive testing plant, advocated by Mr. Gresley, be constructed at once by the railway companies and locomotive builders in collaboration.

Sir Seymour Tritton gave particulars concerning the standardisation of locomotives for India.

Sir Dugald Clerk, referring to the gearing difficulty, said that, much to the surprise of those who were mechanics as well as being interested in the motor, the mechanical change speed gear had proved so far the best.

Mr. J. O. Twinberrow stressed the importance of adopting means of prolonging the life of both tires and rails.

Sir Gordon Hearn, dealing with water supply for

locomotives, said that locomotive engineers in general did not bother a great deal about it; the average locomotive engineer, so long as he could get a certificate from an analyst to the effect that the water was fit for boiler purposes, had to use that water, but when a driver refused to take water at a particular station the matter became serious. It was then that things were looked into, and it was probably found—it had been found in his experience—that the water at that particular station mixed badly with the other water which the locomotive had to take. Certain waters would form a very hard crystalline scale, and in very high-pressure boilers that scale was likely to produce serious explosions. He asked whether that point had been taken into consideration in the design of very high-pressure boilers.

Mr. Lloyd pointed out that as boiler pressures increased, a point must be arrived at at which a boiler became something like a high-explosive shell, and should there be a collision the results would be very much more disastrous than if lower pressures were used.

Mr. H. E. Thompson suggested that it was worth while examining whether a parallel face rail and a level wheel would not be an advantage.

Major E. G. Beaumont (President, Institution of Automobile Engineers), discussing the behaviour of the parts of the running mechanism of locomotives operating at high pressures and temperatures, asked what kind of rod packings were employed for either piston-rods or valve spindles, and whether there was much difficulty at high temperature in maintaining steam-tightness. He also asked how the piston rings behaved, at the customary speeds to-day, and with the lubrication possible at these high temperatures. Further, with regard to valve mechanism, he asked whether the poppet valve or the piston valve was proving to be the superior in these types of engines.

Sir Henry Fowler, replying to a question put by Sir John Aspinall as to whether there was an advantage in giving six or eight blasts per revolution as against four, said that on the three-cylinder "Royal Scot" there were six, and, though he had not been able to ascertain what the advantage was from the point of view of coal consumption, the effect on the fire was decidedly better than when there were four blasts per revolution. Speaking generally, with regard to the high pressure and internal combustion engines, he said that locomotive engineers now more than ever had to consider the financial aspect; there were many things which, if adopted, would give some advantage, but the trouble was that a lot of money had to be spent in order to gain that advantage. One appreciated very fully all that had been said as to the increased efficiency of the internal combustion engine from a thermal standpoint, but one wanted to know what that increased efficiency meant financially. It had been said that what was wanted in the ordinary steam locomotive was a good boiler; what was wanted in the internal combustion engine, however, was a good system of transmission, not only from the mechanical, but also the financial point of view. Replying to Major Beaumont, he said he still used metallic packings. With regard to piston rings, there was a tendency to-day to use very narrow rings, as compared with those used formerly. With regard to water supply, he said that the London, Midland and Scottish Railway Company had adopted a system by which the tanks were painted in different colours. When painted red, it was an indication to the drivers that they must not use the water in those tanks if they could possibly avoid it; the tanks containing water which drivers must use whenever they could were painted yellow. As to poppet valves, he said the London, Midland and Scottish Railway Company had been experimenting with one type and were increasing its use on some engines which were being rebuilt. So far, it was quite satisfactory.

Mr. Gresley, replying to Mr. Thompson, said the resources of the railway companies were not sufficient to enable them to change over to parallel rail-tables and level wheels. Dealing with the efficiency of the ordinary type of steam locomotive, he gave particulars of tests carried out this year on two express engines. One of the engines, of the "Pacific" type, was worked as originally built, with 180 lb. boiler pressure, and the boiler pressure of the other engine was increased to 220 lb., the diameter of the cylinders of the high-pressure boiler being purposely reduced to make the tractive power of the two engines equal, the reduction being from 20in. to 18¼in. Each engine was tested for about a week on express trains running between Doncaster and London, and the same drivers were engaged. There were two sets of men, one set of men running the 180 lb. pressure engine for three days and the 220 lb. pressure engine for three days, and the other set of men working *vice versâ*, with a view to eliminating the variability of the human element. The coal was carefully weighed on and off the engines at the end of each trip, and the coal used for lighting up was kept separate, so that the test results related only to the coal actually used in running. In one week, when the 180 lb. pressure engine was doing the trip, the weather was bad, and when the higher-pressure engine was running, the weather was better. That was clearly shown by the number of draw-bar horse-power hours recorded. The trains weighed about 450 tons on the average. The average coal consumption for the low-pressure engine was 38·83 lb. per mile, and 0·069 lb. per ton-mile; on the higher-pressure engine the average coal consumption was 35·37 lb. per mile and the consumption per ton-mile was 0·062 lb. On one trip, when the train weighed 512 tons the coal consumption per ton-mile was 0·059 lb., which was a very low figure. He mentioned those results in order to indicate what the builders of internal combustion locomotives were up against in beating the ordinary type of steam engine.*

The Chairman, at the conclusion of the discussion, suggested that those who criticised the lack of advance in connection with railway locomotives should bear in mind that whereas marine engineers, automobile engineers and aeroplane engineers had free testing grounds for their experiments, the locomotive engineer had not. In order that experimenters should have an opportunity of showing what their various types of locomotive could do, they needed not only an up-to-date experimental test station, fully equipped, properly located and properly staffed, but also the use of a testing ground on the railway, with suitable inclines, level stretches and curvature. Consideration might be given to that by the Government and the railway companies in collaboration.

The Banquet.

The celebration proceedings terminated on the evening of Thursday, June 7th, when a banquet was held in the Connaught Rooms, Great Queen-street. A large and distinguished gathering, numbering in all some four hundred and fifty, sat down under the chairmanship of the President, Mr. E. F. C. Trench. Possibly, never previously had such an assemblage of eminent engineers and scientists met together in one room. Not only was a large proportion of the leading men in science and engineering of this country present, but the guests included, as well, not a few of the most notable engineers of the Continent and the United States of America. After the usual loyal toasts and that of "The Sovereigns of the Kingdoms and the Presidents of the Republics Represented"—all put forward by the President—had been duly honoured, Sir Brodie H. Henderson, K.C.M.G., a Vice-president of the Institution, proposed the toast of "The Delegates and Other Guests," and coupled with it the names of Sir Richard T. Glazebrook, K.C.B., F.R.S.—who is an honorary member of the Institution—as representing the Royal Society; Mr. A. Dow, as representing the American Society of Mechanical Engineers, of which, this year, he is President; and Dr. C. Lely, as representing the Koninklijk Instituut van Ingenieurs of Holland. Then Sir William H. Ellis, G.B.E., a Past-president of the Institution, offered the toast of "Kindred Institutions," which was replied to by Mr. A. Hazen, a past Vice-president of the American Society of Civil Engineers; Monsieur le Marquis de Chasseloup Laubat, as representing La Société des Ingénieurs Civils de France, of which he is Treasurer; and Sir Henry Fowler, K.B.E., as representing the Institution of Mechanical Engineers, of which he was President last year. Finally the health of the President was drunk, with musical honours, at the call of Lieut.-Colonel the Right Hon. Wilfrid Ashley, P.C., the Minister of Transport.

We make no attempt to report any one of the speeches; to do so, however shortly, would call for more space than we can spare. It must suffice to say that, in all truth, those delivered by visitors from across the seas made a greater impression on all listeners than did those of our own countrymen, and that both Dr. Lely and the Marquis de Chasseloup Laubat spoke in English—and excellent English at that.

(To be continued.)

* A full report of these tests will be found on page 668 of the current issue.—Ed. The E.

A New Type of Levelling and Stadia Staff.

We have recently had brought to our notice a new type of levelling and stadia staff, which has been put on the market by Cooke, Troughton and Simms, Ltd., of Broadway-court, Westminster, S.W. 1. It is known as the "Gayer" staff, and is made in accordance with the patent of Major A. E. Gayer, who is, at present, Principal of the North London School of Surveying, and was formerly Surveyor to the Rand Water Board. Major Gayer has, we understand, devoted much time to the improvement of surveyors' staves, and for the type that he has devised a great many claims are made.

The Gayer staff differs from the Sopwith staff, which is so generally used, in two main features:—It is folding instead of being telescopic, and it is graduated on an entirely different system. The staff is made either two-fold or three-fold, and in various sizes and lengths, giving extended lengths varying from 10ft. to 16ft., and weights varying from 8¾ lb. to 15½ lb. The folded length of the three-fold 16ft. staff is only 5ft. 6in. The component parts are connected together by gun-metal hinges, which are of an exceedingly robust character, and which are so designed that, when the staff is extended, they may be clamped in such a way that relative movement between the component parts of the staff is impossible. The hinges, in fact, struck us as being mechanically strong and satisfactory. The width of the face is the same throughout the length of the staff, and does not taper as in those of telescopic pattern, and, moreover, the graduated face is in the same plane throughout its length. For use in confined situations the lower, or, if the staff is three-fold, the lowest length can readily be detached and used by itself. The arrangements are such that, in both two-fold and three-fold staves, the graduated faces fold inwards so that they are protected from damage during transport.

Being specially intended for use with standard inverting telescope instruments, the figures on the scales on the Gayer staffs are inverted, so that when read they appear the right way up. We reproduce, at half size, the scale of a staff specially intended for levelling and stadia work. It will be seen at once that it differs very considerably from the ordinary Sopwith scale. It is graduated in tenths and hundredths of a foot. For levelling alone, the black squares are omitted and the width of face is reduced from 3in. to just under 2¼in. With regard to the scale, the following explanations are given by the manufacturers:

(1) There is no need to hunt for the "foot" figure, as a large "foot" figure appears opposite every 1/10th foot figure, and all 1/10th foot numbers are shown.

(2) The 1/10th foot figure cut by the horizontal cross-

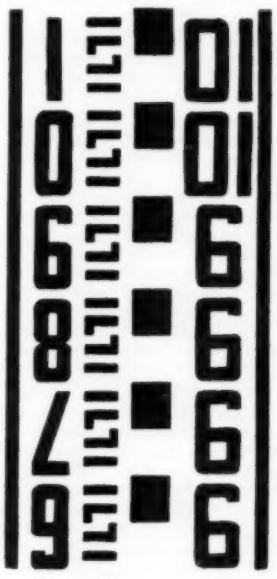


FIG. 1—PART OF GAYER STAFF FACE—HALF SIZE

line—collimation line—of the telescope is the actual number to be booked.

(3) All the figures are black, by which means, it is claimed, the best optical effect is secured. On long shots in bright sunlight red figures are often indistinguishable.

(4) The broken nature of the black and white 1/100 foot divisions considerably lessens the tendency of the scale to merge into a flat grey tint on long shots.

(5) When the horizontal cross-line of the telescope reads exactly 0·05ft., it completes, in conjunction with the adjacent 1/100th foot divisions, a figure 5, as will be seen where the full cross line comes in Fig. 2, which represents a portion of a Gayer scale, as seen through an inverted telescope. In this figure the broken line represents the cross-line of the telescope, and it is shown giving a reading of 5·28. In the staves with black squares for long-range stadia readings, as in our illustrations, the top of the square is exactly in line with the 0·05 marking, which, it is pointed out, still further emphasises that reading.

(6) There are only four black divisions in every space occupying 0·1ft.; hence the chances are in favour of the black horizontal cross lines of the telescope falling on a white background, which is a distinct advantage when

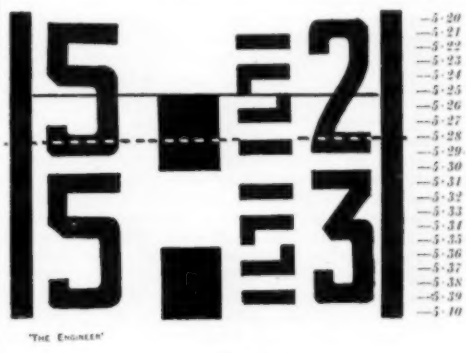


FIG. 2

0·005ft. or finer readings are desired. In the Sopwith scale there are equal numbers of black and white divisions, and the chances of the black horizontal—collimation—line falling on either colour are equal.

We may mention that for those who prefer to work with metric units, a special metrical scale staff has been prepared.

The staves are made of solid, well-seasoned pine, channelled so as to reduce weight. They appear to us to be strong and well able to stand rough usage; considerably more so, in fact, than staves of the telescopic type. The makers assert, too, that there is no danger of the staff being materially affected by damp conditions.

An explosives plant is to be put up near Winnipeg, Manitoba, at a cost of about 1,000,000 dollars, by Canadian Industries, Ltd., which is affiliated with Imperial Chemical Industries of Great Britain.

Incorporated Municipal Electrical Association.

No. I.

THE thirty-third annual conference of the Incorporated Municipal Electrical Association began in Bath on Monday last, the 11th inst., and will be concluded to-morrow. Perhaps it is indicative of the present trend of events that, for the first time for many years, there is no paper on the programme dealing with the generation of electricity. A leading feature of the opening session of the Convention on the technical side was a vigorous criticism by the President—Mr. F. W. Purse, Chief Engineer and Manager of the West Ham electricity undertaking—of the conditions likely to arise under the Electricity Act of 1926.

Mr. Purse, in the course of his presidential address, remarked that great play had been made of the fact that there was a large number of small generating stations that were redundant and ought to be scrapped, but said that he was quite certain that the 500 engineers, with all their skill and ability, all striving their utmost to lower the cost of production, had done more in the past to bring about a full supply of low-priced electricity for all who required it than would the very limited number be able to achieve in the future. He maintained that with the wholesale reduction in the number of generating stations and their *personnel* thrown on the scrap heap, and with true comparisons between the remaining stations rendered impossible because of inter-running, the element of competition would disappear, the individual would lose his individuality, size would take the place of skill, and thermal efficiency would take the place of dollar efficiency. High thermal efficiency and low coal consumption could be obtained by anyone, but at a cost. Generation could be concentrated at a few stations and the supply transmitted all over the country, but at a cost. The only thing that mattered was what the consumer paid for an efficient and reliable supply. Previously, everything was pointing in his favour, but what was the outlook now? There was no guarantee under the Act and he deplored and deprecated in the strongest possible manner the way in which the electricity supply industry in this country—particularly municipal—had been criticised for a state of affairs for which it was not responsible. Having transferred the industry from one state of bondage to another, he hoped the politicians would now leave it alone and remember that that country succeeded best which learned first how to speed up the production of industry and to slow down the production of legislation.

The main features of the Act, continued Mr. Purse, were to provide for the interconnection of practically all supply undertakings in the country, for the eventual supersession of a large percentage of existing generating stations and for what was now termed the "base load" being carried by a few of the largest stations. The "base load" so provided was naturally to be diverted from the many other stations to be shut down or restricted in working, and any benefits derivable from such interconnected working ought to be shared by all which were affected. Unfortunately, the Act conferred the largest benefit on base load stations, which, in the main, would be the largest stations, so that their already favourable position would be made still more favourable at the expense of the smaller and less fortunately placed undertakings. Coupled with that inequitable allocation was the method set forth in the Act for the ascertainment of the average kilowatts of maximum demand, which favoured base load stations, but reacted unfavourably in other cases, as the higher the load factor the higher would be the average maximum demand to be paid for.

On the much debated question of standardisation of frequency Mr. Purse remarked that the die was cast and that it was not worth while again to deal with the *pros* and *cons* of the subject, but that he could safely say that the weight of opinion of those well able to judge did not support the proposals of the Act, and if those who talked so voluminously about standardisation really appreciated it, they would have applied themselves to standardisation of supply to the consumer. Their neglect to do so knocked away many of the arguments that were advanced as to the desirability for standardisation.

After pointing to several other features of the Act, which were referred to as mysteries, Mr. Purse concluded by acknowledging that the Central Electricity Board also had its difficulties. For instance, Section 27 of the Act read:—"The Board may, with the consent of the Electricity Commissioners, and subject to regulations to be made by the Minister of Transport, with the approval of the Treasury, borrow money," a typical example of super-control, he added, of which all in the industry were fellow sufferers. However, he was quite certain that the Board realised as much as the supply authorities that all partners in the business must work together in sympathy and co-operation if they were to solve the multitudinous problems presented. Goodwill, forbearance, and a fair and square deal would produce better results than any Act of Parliament.

The remainder of the opening session of the conference—Tuesday, June 12th—was taken up with a paper by Col. A. Sinclair and Mr. J. W. Burr—Chairman and Engineer respectively of the Swansea Electricity Committee—in which all the details of administration of municipal electricity undertakings were discussed. It was what is popularly known at these conferences as a Councillors' paper. The engineers were specially kept off it and the chairmen and committeemen fought it out amongst themselves. The main point taken up in the discussion was the suggestion in the paper that Electricity Committees should have all the executive powers of a board of directors, but it met with wholesale condemnation, all those speaking on the point, except the authors, seeming almost scared at the drastic nature of the change. However, that did not make the authors in any way repentant, and they stuck to their point to the extent of asserting that their view will yet be adopted.

(To be continued.)

FIRE FLOAT FOR RANGOON

MERRYWEATHER AND SONS, LIMITED, GREENWICH, ENGINEERS

Fire Float for Rangoon.

WE recently had an opportunity of witnessing the trial of a new petrol-driven fire float, which has been supplied by Merryweather and Sons, Ltd., of Greenwich, to the Rangoon Corporation Fire Brigade. This boat is of the twin-screw type, and is shown in the engraving above, while the illustrations on page 660 are of the engine-room and the deck fittings. She has been built to the general designs and specifications furnished by Mr. G. Lee Tuppen, M.I. Mech. E., M.I. Fire E., the Chief Officer of the Rangoon Fire Brigade, and has several novel features necessitated by the conditions that obtain in the service for which the boat is required. Light draught with the highest possible speed are essential, and special precautions have been taken to guard against damage to the propellers by the floating logs that abound in the navigable waterways of the river Irrawaddy and its creeks.

The vessel has been built throughout under Lloyds special survey, and is classed 100 A1 for fire floats. The hull is of British steel throughout, the whole of the outside plating being galvanised. It is 75ft. in length with a beam of 13ft. 3in., and a maximum draught of 2ft. 10in. There are four water-tight bulkheads forming a chain locker, cabin, fuel compartment, engine-room, and hose and equipment compartment. A flush deck extends for the whole length of the vessel, which is covered by a curved corrugated steel awning extending to within 5ft. from the bow, giving a head room of 6ft. 6in., and arrangements are made for a second canvas awning beneath. A skeleton teak platform is fitted forward on which are mounted the monitor and delivery hose connections—plainly shown on page 660.

Two compensated rudders are fitted, and the twin-screws revolve in tunnels of special design, the rudders and screws being strongly guarded by streamline bars of substantial construction. The propellers are of high-tension bronze, and Vickers glands are arranged between the extremity of the stem tubes and the forward faces of the propeller bosses.

Two Ricardo petrol motors are fitted, and are used alternatively for propelling the vessel or driving the pumps. Each engine has six cylinders 6¼ diameter by 7½ stroke, and is capable of developing 200 H.P. when running at 1000 revolutions per minute. Each cylinder has two exhaust and two inlet valves fitted horizontally in the cylinder heads. The pistons have an extension downward running in a cylindrical guide and forming a crosshead, to which the small ends of the connecting rods are attached, thus eliminating all side thrust from the pistons on to the cylinder walls. Twin Zenith carburetters are used, and the ignition arrangements are in duplicate, by high-tension magneto and battery and coil. The lubricating system to the main bearings and crank pins is of the forced type, the pressure being registered on a gauge and regulated by an adjustable relief valve. The other internal parts of the engine are lubricated by splash from the crank chamber.

The water circulation system is duplicated throughout, and of an entirely special nature to prevent the access of dirt to the cylinder jackets when the boat is working in muddy water, which will be more often than not. A positive action pump taking its supply from overboard is fitted to each engine for operating in clean water, while large radiators are fitted on deck working on the thermo-syphon system, with an induced draught furnished by the exhaust discharge into the uptake. These radiators can be seen just below the awning deck in the engraving above. The fuel tanks are provided each of 150 gallons capacity and an Auto-vac supply system is installed to feed the carburetters.

The reverse gears are of the positive action type operated by dog clutches, and the reversing takes place by the putting into action of wheels revolving loosely on a lay shaft. The clutches are operated by a single hand lever, and foot pedals actuate friction brakes on drums fitted to the main shafts. The thrust blocks are of the ball-thrust type, and are housed in the same casting that carries the reverse gear.

The pumps are of the Merryweather three-stage turbine type, one of which is illustrated on page 660. They are constructed entirely of gun-metal and are similar to those in use on the London Fire Float Beta III, which was described in THE ENGINEER of February 12th, 1926. They are driven by a silent chain gearing, running totally enclosed in cast iron casings fitted between the fly-wheel and reverse gear, and are put in and out of gear by hand-operated dog clutches.

Each pump is designed to deliver 900 gallons per minute at a pressure of 140 lb. per square inch; 1050 gallons per minute at a pressure of 120 lb. per square inch; 1250 gallons per minute at a pressure of 100 lb. per square inch; 2100 gallons per minute at a pressure of 40 lb. per square inch.

The pump suction inlets are below the water-line with extensions to the deck for salvage work, and are arranged so that either or both pumps can take their supply from either side of the ship, and strainers of large area are fitted in welded steel chambers conveniently arranged for access from the engine-room floor. Two salvage suction heads are fitted on deck, each having three inlets for the attachment of 6in. diameter suction piping.

A monitor controlled by a balanced hand lever—see page 660—and operating in all directions, is fixed to a platform over the awning, and connected with the pump deliveries. It has a 5in. diameter water way, and is capable of delivering a single high-pressure stream of 3½in. diameter. There are eight delivery outlets on deck for 2½in. diameter fire hose, and a single 4in. diameter outlet for use with a portable land monitor.

There is a combined electric lighting and starting equipment in which the switching on of a light automatically starts up the dynamo. The hull is wired up throughout with lights in all compartments, and a powerful search-light is fixed forward. A separate motor is provided for driving a vacuum pump for charging the suction pipes.

On the occasion of the trials to which we have referred, a speed of 11 knots was attained, while the handiness of the boat was well demonstrated in turning and getting alongside. Pumping demonstrations were also given with the monitor and the hose connections, and jets of remarkable solidarity were obtained in each case. Since then the float has been shipped whole, as deck cargo, to Rangoon, but the heavier pieces of machinery had to be removed on account of the limits of the lifting gear at the destination.

WE learn from the *Faraday House Journal* that Mr. G. W. Partridge, in collaboration with Messrs. Ferguson, Pailin, Ltd., has developed a surge recorder. This instrument gives a record of the actual time of a surge, and in many cases this knowlege will make clear the cause of the disturbance.

Railway Matters.

AN express from Frankfurt to Munich was derailed near Nuremburg, in the early hours of Sunday, the 10th inst., when about twenty persons, including the driver and fireman, were killed.

IN reporting on the fatal injuries received by a signal lampman when cleaning a signal lamp, owing to the man having grasped one of the catenary wires of the overhead equipment on the old "Brighton" section, Mr. Scott Main, the assistant to the chief inspecting officer of railways, said that there was, he understood, an idea prevalent among the staff that the dangerous element to come in contact with, so far as the overhead equipment is concerned, was the running wire. He adds that the unfortunate man's successor, who had had considerable service, was under the impression, until otherwise informed, that no danger would result if the catenary wire was grasped. Mr. Main made suitable recommendations accordingly.

RAILWAY servants have many interests outside their regular work with which they collectively identify themselves—in athletics, music, theatricals, horticulture, &c.—of which possibly the keenest is ambulance work. The services in that direction which railway servants often render were made manifest in a remark made by Viscount Churchill when presenting ambulance awards to certain Great Western men recently. First-aid treatment in twenty-three cases formed the subject of the awards, and it was an interesting point that fourteen of those cases happened outside railway premises and were in no way connected with the railway beyond the fact that it was a railway-trained ambulance worker who had gone to their aid.

THE grouping of the railways of Great Britain was authorised in 1921, and was completed in a little over twelve months; the grouping of the railways of the United States was authorised in 1920, but no scheme of consolidation of any size has, as yet, been sanctioned. There is, it is true, a great difference between the possibilities of the two countries. For instance, all the grouping in the United States is voluntary; there is not the urgent need for concentration that there was in this country, and, above all, the Inter-state Commerce Commission is the approving authority. We are led to mention this matter by the recent refusal of the Commission to sanction the Chesapeake and Ohio and the Pere Marquette Companies to be amalgamated, and for the new company to acquire the Erie. The amalgamation was agreed to but not the acquisition.

A VERY pleasing incident occurred at Holyhead on Monday last. Mr. Cosgrave, the President of the Irish Free State, and a party of about 120, were entertained to luncheon by the London, Midland and Scottish Railway, and inspected the company's facilities for handling perishable traffic. Sir Josiah Stamp, in welcoming the guests, said that forty specially adapted wagons had been provided, and produce leaving Dublin at 1 p.m. could be in London at 4.30 next morning and on sale at 5 or 6 a.m., while afternoon consignments from Dublin reached London the following afternoon. Mr. Cosgrave, in his reply, said that the Free State Government had arranged for a series of experiments on British and Irish railways to be undertaken with a view to determining the most suitable type of vehicle for carrying cooled dairy produce, and all the railway companies were co-operating.

As the London, Midland and Scottish mail train from Lincoln to Tamworth was passing through Swinderby, near Newark, on the evening of Wednesday, June 6th, the engine was derailed and ran down the embankment, being followed by some of the coaches. One passenger received such serious injuries that he died in the hospital that night. The coroner's inquest stands adjourned until to-morrow—Saturday. The cause had not, at the time of writing, been disclosed, but as the railway company, at the opening of the inquest, accepted responsibility, it is clear that the fault lay with either the engine or the track. The accident was unfortunate in that it was the first instance this year in which a passenger has been killed in a railway accident. Actually, it was the first for a period of exactly six months, and on the previous occasion—a collision in a fog—there also was only one passenger killed.

THE mishap that occurred to a London, Midland and Scottish train at Swinderby, near Newark, on the evening of June 6th, reminds one of the ramifications of the Travelling Post Office, and how the mail train workings instituted in the early days of railways remain in force to-day. One of the busy postal exchange centres is Tamworth, where the former London and North-Western main line is crossed by the Derby and Bristol line of the Midland. The train involved in the accident in question was what, for the last sixty years at least, has been known as the Tamworth Mail. It leaves Lincoln, with a Post Office sorting van and tender, at 8 p.m. for Tamworth, calling at Nottingham and Derby. It arrives at Tamworth at 10.22, in time for its mails to the North to be handed into the down postal train, which calls at Tamworth about 10.45. After the up postal train has called at that station the train from Lincoln—now known as the Lincoln Mail—leaves Tamworth at 2.25, calls at Derby and Nottingham, and arrives Lincoln 4.51.

As anticipated in this column on June 1st further new electrical services from London Bridge will be started on Sunday next. The new large signal-box at London Bridge will also be brought into use. It contains 311 levers, and is the largest all-electric power-operated box in this country. As the track and signalling alterations are on a very extensive scale, it has very wisely been decided to divert some of the business trains into Victoria for a few days, whilst some up trains will terminate at and return from East Croydon. It, further, has been decided to treat some of the morning trains in the same way as has been done, since March 17th, with the trains from the Tadworth and Caterham branches, *i.e.*, to stop them at London Bridge. By the reconstruction of an overbridge facilities have been given for passengers quickly to reach the other platforms for Cannon-street and Charing Cross. The general manager, Sir Herbert Walker, has issued a letter to all London season-ticket holders explaining these changes and the necessity for them.

Notes and Memoranda.

A NEW Diesel-electric towboat, the "Tecumseh," the fourth of its kind to be built and the second of its size to be equipped with Diesel-electric propulsion, is shortly to be put in service in the St. Louis district by the United States Engineering Corps. The power plant of this boat consists of a 300 horse-power Lombard Diesel engine driving a 210-kilowatt 190 to 315-volt generator and a 20-kilowatt 120-volt compound-wound generator. The larger generator will supply power to two 115 horse-power 360 to 600 r.p.m. shunt-wound propulsion motors, and the smaller generator will supply power for running auxiliaries and for lighting, as well as excitation for the main generator and propelling motors. The propeller is of the paddle-wheel type, arranged at the stern, and is driven through two sets of link-belt chains.

SYNCHRONISING of alternating-current generators, states *Power*, may be done in various ways, but where the machines are put on the system one at a time, they are usually brought up to speed and voltage and the speed adjusted to bring them into synchronism before closing the switch. In one case where the exciter circuit breaker tripped out and the voltage was lost on four machines operating in parallel, the feeder switches were opened and the generators were left connected to the bus-bars. The exciter was started and brought up to voltage while connected to the alternator fields. When the voltage of the alternators reached near normal, the four machines pulled into step. This operation required only about three minutes, compared to ten or fifteen that would have been required if each machine was synchronised separately.

IF experiments made by three German scientists on Monte Generoso, near Lugano, Switzerland, continue to be successful, it looks as if Nature were going to provide the pressures requisite to smash the atom. According to the *Faraday House Journal* they use a wide meshed wire net having an area of seven hundred square yards. This is hung by means of a cable between two mountain peaks at a height of about 250ft., and is supported by long chains of insulators. A spark-gap which could be lengthened until the electrodes were 15ft. apart was adjusted in a lightning-proof hut made of metal. One of the electrodes was connected with the wire net aerial. During a storm the sparks jump across the gap at the rate of about one per second. This lasts sometimes for as long as thirty minutes. It is hoped to attain pressures up to 30 million volts.

IN a western coal mine of the United States of fairly large capacity, which had a record of no fatalities over a comparatively long period, a conveyor system was installed in one place, and within a year there had been three fatalities, one at a time, in the one working place served by the conveyor. Here the trouble seemed to be largely a matter of too much noise by the conveyor, the workers being unable to hear the usual slight warning noises preceding the falling of rib or roof material when the older method of working was utilised. The occurrence of accidents when excessive noise at working faces drowns the noise of props or roof falling is difficult to avoid. Face machinery should, according to the Bureau of Mines, be kept well oiled and in good repair, and should be stopped at intervals to allow surrounding conditions to be ascertained. Water used to wet the coal tends to reduce the noise from conveyors, scrapers, loaders, &c.

IT is a matter of common experience that the materials ordinarily used for colouring the lines and figures on etched-stem thermometers are not permanent under all conditions of use. The colour in the lines of chemical thermometers burns out at high temperatures, and at lower temperatures is removed by the action of the fluids in which the thermometers are immersed. For clinical thermometers no material has been found which would not be removed by some of the antiseptic solutions commonly used. A new material invented by Mr. Paul T. Hannen and Mr. H. D. Bruce, of the United States Bureau of Standards, is claimed to be much superior in durability to those now in use. It consists of a mixture of water-glass and finely divided manganese dioxide, which is applied as a paste. A thermometer treated with this material is said to retain the colour even when heated to 500 deg. Cent., and can be used in hot oil, water or steam without injuriously affecting the visibility of the lines, while clinical thermometers may be treated with any of the common antiseptic solutions without removing this colouring material. The ability of the material to resist attack by acids and alkalis has not been thoroughly tested, but the indications are that it is not entirely resistant to them.

EAR tests developed in the Bell Telephone Laboratories, New York, make use of accurate electrical instruments which, with psychological aids, determine a person's exact degree of hearing. False claims for either deafness or exceptional hearing are of no avail, for the truth can now be easily discovered. A push-button on the instrument which measures the tone emitted for the test permits the interruption of the sound at any moment. If a patient says he hears a tone, and then claims that he still hears it when it has been cut off, it is evident that he has been deceiving himself. Another device makes it possible to switch the sound to either ear or both. A loud tone in either ear causes the eye nearer it to blink slightly, though the patient may claim that he hears nothing. The patient is made to read aloud in his normal voice in another test, while a tone is switched from ear to ear. If he is deaf in one ear, he will raise his voice every time the tone sounds in his normal ear. When the tone is switched on and off both ears, a person with normal hearing will raise his voice each time the tone is turned on, while one who is deaf, will continue to read without changing his voice. To detect a false claim of deafness in one ear, the tone is switched repeatedly back and forth between the ears at varying intensity, and the patient is asked to signal each time he hears a sound. A truthful signal can be made almost instantaneously, but if the patient must stop to decide each time in which ear he hears the sound, much more time is required and he quickly becomes confused, thus betraying himself. These tests are expected to prove valuable in compensation cases in which loss of hearing is involved.

Miscellanea.

IT is reported that a German geologist has discovered extensive coal deposits and manganese ore bodies between Kirman and Yezd in Persia.

A RUBBER tire factory, which will give employment to about 1000 hands, is to be put up at Burton-on-Trent by the Pirelli-General Cable Works, Ltd.

AS much as 12,000,000 dollars is to be spent within the next three years at Sault Ste. Marie, Ontario, on the conversion of Michipicoten Harbour into a great coal-distributing port, the erection of an iron smelter, rolling mills and a benzol plant.

THE Canadian Pacific Railway, in designing forty-four new locomotives, has decided to use a 3 per cent. nickel steel boiler plate of 70,000 lb. (31·25 tons per square inch) minimum tensile strength. Its use will permit an increase in boiler pressure from 200 lb. to 250 lb. per square inch without any change in the thickness of the boiler plate.

THE contract for providing a third unit to supply an additional 3000 H.P. to the civic hydro-electric light and power plant at Upper Bonnington Falls, British Columbia, has been secured by Stuart Cameron and Co., Ltd., Vancouver. The total cost of the addition, including electric installation, is estimated at 240,000 dollars. The Canadian General Electric will supply and install the plant.

HIS MAJESTY'S Consul-General at Valparaiso, Mr. Constantine Graham, reports that the development committee of a certain municipality in Chile is making inquiries regarding the most up-to-date system of sewage destruction and sewage recovery. Further particulars can be obtained by British firms on application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1 (reference A X 6391).

ACCORDING to the *Iron and Coal Trades Review*, the South African Railway Administration during the past four years has been using steel sleepers in increasing quantities. These have been found to be more economical on light branch lines and on certain sections of the main system than timber sleepers. Present plans are not to use steel sleepers to the total exclusion of timber, but the Administration favours the former whenever conditions are suited to their use.

A NEW metal, to which the name of Apso has been given, has been produced by the French Société des Hauts Forneaux, Forges et Aciéries de Pompey. It is a rust-resisting metal which, owing to its low price, may be used for heavy structural work. Its tensile strength is low, namely, 35 kilos. to 40 kilos. per square millimetre (22·2 to 25·4 tons per square inch) only, with a minimum extension of 28 per cent. It is very plastic, easily worked cold, it may be used in the form of castings, forgings and rolled products, is easily welded, and may be used also for all kinds of stampings and other sheet metal work.

THE daily capacity of the St. Lawrence Paper Mills Company's plant at Three Rivers, Quebec, will be raised to 450 tons a day by the end of the present year. Additions to the plant are now being carried out by the Foundation Company, Ltd., to enable the installation of two additional newsprint machines with a daily capacity of 75 tons each. At the present time the plant has four machines in operation, with a daily capacity of approximately 300 tons. The company has placed the contract for the two new paper machines with the Dominion Engineering Works, Ltd., subsidiary of the Dominion Bridge Company.

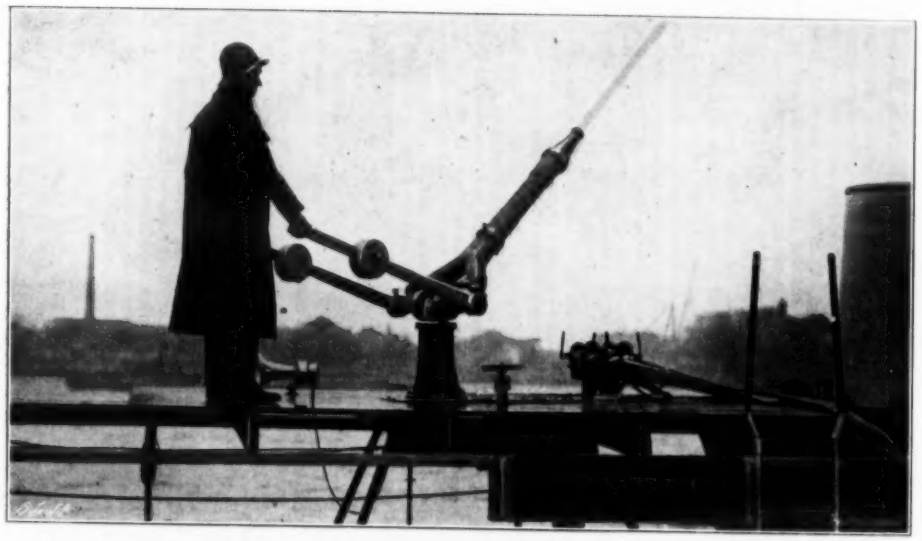
As a result of the success of the scheme, begun in the summer of 1921, to provide engineering students of the Liverpool University with practical experience during vacation, the White Star Line has again arranged for a further number of students to sail on board the liners during the coming summer months. That scheme, which was drawn up by Mr. W. J. Willett-Bruce, the late superintendent engineer of the line, with the approval of the managers, provides for about twenty-four students to make the Atlantic voyage in either the New York or Canadian service, one student to a sailing, commencing the first week in July, continuing on till about September next. The students will take watch with experienced marine engineers, assist in the running of engines and boilers, certain auxiliaries, and also take part in the overhaul of deck machinery. Hitherto most students during vacation have gone into works ashore, but the departure made by the White Star Line has proved of inestimable value to marine engineering students in that it gives to them knowledge which cannot be gained in engine works.

IN the report of the Advisory Committee for the William Froude National Tank at the National Physical Laboratory, which has just been issued by H.M. Stationery Office, it is stated that the staff of the Tank has been increased by the addition of Mr. Sprague, as temporary research worker, and one mechanic. Mr. Sprague had been holding an 1851 Exhibition Scholarship at the Tank until October 1st, and had assisted in the routine work. In the early part of 1920 the hours during which the Tank was at work were increased. The work now continues from 7.45 a.m. to 9 p.m. during the first five days of the week. The main object of this extension of working hours is to secure a reasonable proportion of the working time for systematic research work. The steady growth in the work of testing models for commercial firms during the last few years has made it evident that the provision of further facilities for such testing is necessary, if ship research work and the output of research in connection with flying boats and seaplanes and the type testing of such forms are to be maintained as they should be. Proposals were made to the Air Ministry in 1925 that a new high-speed tank should be built for the latter work on a site close to the existing tank. To maintain the output of commercial mercantile test work and of general research, the testing of model seaplane and flying-boat forms was greatly diminished early in 1926, and only a few types of forms have since been dealt with in the Tank. The pressure is now being felt by the ship research work, and during the present year it has been possible to devote only 18 per cent. of the working time to such research. The proposal for a high-speed tank has not been adopted, but the site remains—at least for the time being—if money could be secured for building a new tank.

TWIN-SCREW FIRE BOAT FOR RANGOON

MERRYWEATHER AND SONS, LTD., GREENWICH, ENGINEERS

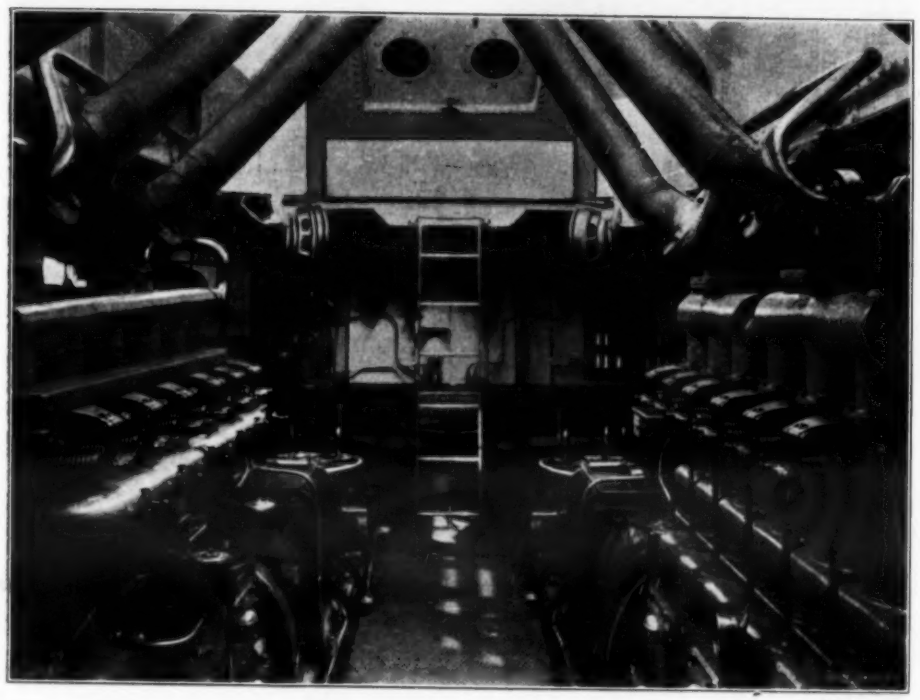
(*For description see page* 658)



MONITOR ON DECK

VIEW OF DECK SHOWING MANIFOLD FITTINGS

ONE OF THE MAIN PUMPS



GENERAL VIEW OF ENGINE-ROOM

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THE ENGINEER.

JUNE 15, 1928.

Locomotive Developments.

THE short paper presented by Sir Henry Fowler and Mr. Gresley at the Engineering Conference on Thursday morning of last week dealt quite briefly with recent locomotive construction, and drew attention to the development of designs of other than orthodox types. The authors' purpose was to arouse discussion on the relative merits of steam locomotives, and other types and also to draw attention to the essential differences of boiler design and cylinder arrangement to be found in representative designs of locomotives of what may be termed the conventional type. In certain respects the discussion of this ever-green subject was disappointing, for whilst the normal locomotive received some attention, others, with the exception of the Winterthur engine, received very little. Whilst this is to be deplored, it is, as a matter of fact, really what might be expected, because we, in this country, have little experience of any locomotives save those of the orthodox type. The Winterthur locomotive, which we have briefly referred to in our pages, has a special type of high-pressure boiler and a high-speed engine, with other refinements in the form of a feed-heating system and an economiser. High economy in steam and fuel is claimed as a result of the combination of these devices, a steam pressure of 850 lb. utilised in a high-speed engine, and a poppet valve gear. The turbine locomotive received little attention, owing, we can only suppose, to the fact that sufficient data have not yet been collected by British makers to permit of general conclusions being formed. The Kitson-Still locomotive is, of course, of such recent date that it would be premature, perhaps, to discuss its performance. It is, nevertheless, to be regretted that these engines received no consideration in the discussion. Another point which is of some interest will be noticed by those who read the paper. In the list given of modern British locomotives, all the engines are of the simple-expansion type, whereas all the continental designs shown in another tabulated statement are compounds. This may be significant, but it is remarkable that little mention was made of compound engines by those taking part in the discussion. In the future, things may be different, for the growing tendency to use higher pressures and the gradual extension of non-stop runs may once again direct attention to the application of the compound principle.

In reviewing generally the present trend of development, one fact becomes apparent. It is the great and far-reaching improvements which are continually being made in the design of the steam locomotive, which result in better performance and which, without doubt, strengthen its already strong position as still the most effective and commercially efficient means of providing railway motive power. There are certain very definite reasons for the improvements which are manifest in recent construction. In the first place, much more is now known of the principles on which boiler design and proportions are founded, and in many other respects the work carried out on testing plants has broadened our knowledge, and, secondly, what is more important, designers are making use of the information now available, so that locomotives of comparatively simple construction designed and built, with the elements essential to success kept well in view, are giving working results hardly thought of but a few years ago. In spite of this notable progress, however, we do not hestiate to say that the development of the steam locomotive is far from complete. Avenues which give promise of providing opportunities for further improvement still remain to be explored. There are, for example, already well-marked indications that valve gear changes which will influence for the better cylinder performance to at least as great an extent as that attained by the use of the long lap as against the short lap slide valve, are taking place. As an indication of what can be accomplished with a simple expansion locomotive of normal design, the fuel consumption figures given by Mr. Gresley in the course of his remarks are of exceptional interest. Mr. Gresley has, as is well known, rebuilt some of his "Pacifics" with boilers having a higher steam pressure than has been his usual practice. The pressure adopted is 220 lb., as against 180 lb. previously employed, and further opportunity was taken to increase the size of the superheater, which is larger by some 34 per cent. Trials carried out between King's Cross and Doncaster have given some astonishing results, as shown by tables which we print on page 668. Mr. Gresley said he had taken two of his "Pacifics," one having the usual 20in. cylinders and the original boiler with a working steam pressure of 180 lb., and the other a new boiler of the same general dimensions, but with the modifications to which we have referred, and cylinders reduced in size to 18½in. in order to preserve closely the same tractive effort. The two engines have run in competition, working express trains of 425 to 500 tons approximately behind the tender. For the engine working at 180 lb., the coal per mile averaged 38·8 lb. and per gross ton-mile ·069 lb.; whilst that working at 220 lb., gave the remarkable figures of 35·37 lb. per mile and ·062 lb. per ton-mile, the least ton-mile figure being ·059 lb. These are averages drawn from a series in which there are great variations and we advise our readers to study, in this connection, the tables given on page 668. It is an interesting fact that the coal per draw-bar horse-power was lower for the 180 lb. engine than for the 220 lb. On the other hand, the speed attained by the high-pressure engine was on the whole greater than that of the low. It must, however, be observed that the former was favoured by better weather. Making due allowance for good coal and expert handling, the figures for both engines, and more especially—as far as coal per ton-mile is concerned—for that having the higher steam pressure, are excellent, and, indeed, are better than any which have so far come to our knowledge. With results such as these attainable, it is certain that the present type of steam locomotive is destined to be with us for some time to come, and whilst there will be no relaxing of effort on the part of those who are working to produce something better, it is equally certain that improvements which are being made, not only in design, but also in the operation and utilisation of the ordinary locomotive, are fast narrowing the field of possible gain by the adoption of new types. In other words, the improvements which are being effected in locomotives of the normal type are so good that the problem of those who advance radically different designs becomes daily more difficult. They have not only to show a still greater reduction of fuel consumption, but have to prove that it can be secured without such an increase of

capital and maintenance charges as wipes out the apparent gains. New types must face new figures.

We were glad to observe that several speakers referred to the need of a really efficient locomotive testing plant in this country. Since Mr. Gresley brought the proposal forward in his presidential address to the Institution of Locomotive Engineers, the weight of opinion in favour of the provision of a plant of the kind has steadily increased, and we may safely take it now that in railway and locomotive circles the need of it is universally admitted. Whenever ordinary road tests are made with locomotives, anomalies arise, partly owing to inevitable changes of conditions, and partly to the difficulty of making accurate measurements and observations on a travelling locomotive. It is only by submitting locomotives to tests in a scientifically organised plant under the management and operation of experienced observers that we shall ever be able to find out with certainty what their qualities are, and to obtain that scientific guidance in the making of changes which may lead to the improvement of their efficiency. The capital expenditure upon such a plant and the annual cost of its maintenance would be trifling by comparison with the advantages that must inevitably accrue, at a time when the modification of existing types and the introduction of new types render careful research imperative.

Pupils and Works.

ALL the year round, but particularly at this season when college sessions are drawing to an end, we receive inquiries from young engineers who want to enter works or join civil engineers or contractors for a few years of practical training. Many of the inquiries are made by students in British technical colleges, but a few always come from the Dominions, from America, and even from continental schools. It is not easy to make helpful answers. We can send our correspondents lists of firms which are known to accept college students for practical training, but we have no means of knowing if vacancies exist, and in many cases we are unable to give any indication of the nature or terms of the indentures or agreement. Alternatively, we may point out to the applicants that if they are student members of the leading Engineering Institutions, the secretaries may be able to help them; or, finally, we may advise them to seek the advice of their own professors, although we may be fairly confident that they have done so before applying to us.

For many years it has been recognised by engineering employers that practical workshop experience is an essential part of the training of young engineers. We are not now speaking of the training of trade lads, as they are sometimes called, to whom apprenticeship in a craft is an obvious essential; but of those youths who have received an education of university standing, and whose object is not so much to acquire skill in the use of their hands as an intimate acquaintance with workshop methods, and, above all, with the mentality of workshops. There is, it is true, a certain amount of opposition to this principle, but it is still adhered to by the great engineering institutions, and the number of engineering employers who are not confirmed believers in it must be small indeed. We have to admit with much regret that it is being undermined by some of the great chemical organisations, which are taking the best men at seductive wages into their employment straight from college and without adequate practical training. That, however, we may regard as a passing phase, and it can have on the whole but little effect upon the engineering industry. In that industry the opinion is still firmly held that three or four years must be spent in the works before the young engineer can claim to be sufficiently trained to take a post of even minor responsibility. That being so, every works engineer must be deemed, in a greater or less degree, responsible for the continuation of the education of the rising generation of engineers. Each one is under a tacit obligation to do what he can, and in as far as circumstances will permit, to give opportunities to students for the acquisition of workshop knowledge and experience. Not very many years ago apprentices had to pay heavily for their indentures, and the "masters" of big works drew from them a far from inconsiderable annual sum in that way. That practice has diminished almost to the point of disappearance. The fees charged are as a rule no more than may be reasonably asked for the facilities and conveniences that are provided for pupils, and, moreover, the pupils are paid wages on a weekly scale far greater than the purely nominal sums which used to prevail. The change has come about because employers no longer regard the pupil or apprentice as a youth whose purse may be exploited, and who may be left to acquire knowledge how and when he can, but as one to whom the employer has a definite duty for the benefit and progress of his profession. In view of this change of attitude towards pupil apprentices, it is strange that no serious effort has been made to put the organisation for such training on a properly arranged basis. In the great industrial centres there is some co-ordination between the colleges and the works, and we may assume, rather than state as a known fact, that the colleges are acquainted with the vacancies for pupils which exist in the neighbouring works, with the nature of the work, the standard of training and the terms of agreement. But there are hundreds of works which are not in touch with any college at all, and which take no steps of any kind to let students know that openings exist. The greater institutions do a little, but in a rather haphazard way. Hence it comes about that there is no central organisation to which a young man can apply for full information. He can do no more than send out applications broadcast, and hope that one of them may be successful. In this way he may waste many valuable weeks or months, and in the end may find that he has to continue his training in a class of works very different from that which he desired.

We point out these facts, which are brought prominently to our attention every year, to urge upon manufacturing engineers, and upon contractors as far as civil engineering is concerned, the desirability—let us say rather the real necessity—of setting up an effective organisation for the placing of students. What is required in the first place is that each works should be encouraged to take as many pupils as it can adequately handle; that it should then send to some central body a clear statement of its conditions and a copy of the form of agreement; and, finally, that it should periodically advise the central body what vacancies for pupils existed. The great institutions could, of course, each do a great deal in this way in their own fields, but they would naturally favour their own members, and there are still many, both amongst employers and students, who are not connected with them, but whose case cannot therefore be neglected. We are not shirking our own responsibilities in this matter; we are very glad to do what we can for young engineers, and would be very willing to do more if works managers would let us know from time to time what number of pupils they are ready to accept and the conditions of pupilage; but at the same time we feel that an *ad hoc* organisation, formed perhaps through the co-operation of the great institutions, is needed. It would not be a costly or a large organisation, and with the voluntary help of engineers and contractors, it should, once started, continue to function almost automatically. We believe that the adoption of some scheme of the kind is in contemplation in the United States, and as it is even more badly needed in this country, we trust our suggestion will, at least, receive consideration.

The Stevenson Creek Experimental Arch Dam.

THE design, purpose and testing of the Stevenson Creek experimental arch dam in the United States were described in THE ENGINEER of May 4th, 1928, and since that article was written a preliminary report on the subject has been issued by the American Society of Civil Engineers. From this report some notes have been made to supplement the information given in the above-mentioned article.

For one thing, perhaps it was not made sufficiently clear that the very light or thin section of the dam—2ft. for a considerable part of its 60ft. height—was not intended as an example to be followed in dams built for permanent use. The dimensions of this test dam were selected with a view to getting deformations as large as possible under the test loads, thus making their measurement easier and increasing the accuracy of the observations.

In order to check and supplement the results of tests of the Stevenson Dam, the Engineering Committee has made tests on and observations of a number of arch dams built for irrigation and water supply projects. In general, however, it was difficult to obtain satisfactory measurements of strains and deflections and to determine temperature variations in the body of these dams. It is pointed out that weeks or months usually elapse before the reservoir level alters sufficiently to produce substantial changes in deflections and strains due to varying loads. But during the same period of change in water level there may be deformations of the concrete—due to temperature changes, moisture content of concrete or yielding under continuous load—of such magnitude as to obliterate the strains due to changes of the water load. In some cases the reservoirs do not become full every year, and in others the reservoirs are never quite emptied, so that readings under conditions of full-load and no-load cannot be obtained within a reasonable time. However, certain dams have instruments which were placed in them during construction and which permit of observations as to conditions from time to time.

Mention was made in the earlier article of tests on models of the Stevenson Creek Dam. A concrete model one-twelfth the size will be tested at the University of Colorado. Since information is already on record as to deflections, strains, bending, movement of abutments, temperature effects and other matters at the actual dam, it may be expected that similar information obtained with the model will indicate the relations between the actual dam under water load and the model dam loaded with mercury. This loading will be applied by forcing the mercury into a rubber bag placed between the upstream face of the model dam and a sheet of ¼in. steel curved to the radius of this face, the plate being backed by timber bracing. The resulting strains at the downstream face will be measured with a Tuckerman optical strain gauge.

For tests of models of dams at the University a concrete pit of elongated octagonal form has been built. It is 18ft. long and 12ft. wide at the top, 5ft. deep, and with stepped sides reducing the size at the bottom to 11ft. in length and 4ft. in width.

A smaller model, one-fortieth of the size of the actual dam, and made of celluloid, has already been tested—also by mercury loading—at Princeton University. A reservoir was formed by a curved sheet of celluloid placed ¼in. from the upstream face of the model, this reservoir being connected by a rubber tube with an iron vessel holding 100 lb. of mercury. The container was suspended from a chain hoist and was raised or lowered to fill or empty the reservoir. Deflections of points on the downstream face of the dam were communicated through wooden rods to Ames dials reading to 0·001in. Strains in this face were measured with a Tuckerman optical strain gauge, which gave readings to 0·000001in. per inch on a gauge length of 2in.

As a strain gauge could not be used on the upstream face, when the reservoir was filled with mercury, two steel needles 15in. long were set in holes in the model at the ends of each 2in. gauge length for which the strain on the downstream face had been measured. Corks on these needles carried pins, the two points of which could be observed in the field of a filar micrometer microscope reading to 0·0001in. The movements of these pin points on emptying the reservoir determined the angular movement of the needles. Calculations indicated that there was very little vertical tension or compression at the middle surface of the model. From the deformation tests it appears that the maximum stress on the downstream face of a dam may be found by determining vertical and horizontal stresses and disregarding inclined stresses.

As a result of these tests it was concluded that quantitative predictions of deflection and strain can be made for the actual dam from the tests on the celluloid model. Also, that these predictions based on model tests agree more closely with the actual observations than would the results of practical mathematical analysis. Further, even closer agreement between the model and the dam might be expected if the model had been cut where its tension indicated that cracks would form in the actual dam.

It is pointed out in the report that, as the investigation is still in the stage of research, it would be premature to reduce the results thus far obtained to definite guides in the design and construction of dams. A year or more will be required to finish the work and studies and to prepare the complete or final report. Nevertheless, certain tentative conclusions are submitted, subject to future modification.

Tentative Conclusions.—(1) Tests of the Stevenson Creek Dam have demonstrated the great strength of a thin, unreinforced concrete arch dam, if well built and on proper foundations. Experience has shown the ability of such a dam to resist floods. Concrete dams consisting of a single arch are usually built without steel reinforcement, as little, if any, advantage would be gained by its use, except that special conditions in some dams may make reinforcement advantageous in particular parts.

(2) These tests have yielded positive information as to how this arch dam carries its load of water pressure and resists other forces acting upon it.

(3) These tests have supplied data which appear to be suitable for use in devising rational methods for the intelligent design of arch dams and for examining the stability of existing arch dams, within some limits not yet determined.

(4) Indications of agreement with the Stevenson Creek results have been obtained by investigations on one large dam in service and by tests on the small model at Princeton University. Such agreement gives assurance that some dependable experimental knowledge has been obtained to confirm or modify assumptions which heretofore have guided the design of arch dams.

(5) Agreement between the results on the Princeton model and the Stevenson Creek Dam indicate that small models may be used confidently by competent engineers for seeking further general information regarding arch dams, or for determining the strength of proposed or existing dams at a small fraction of the cost of tests on a full-sized dam or on a model dam large enough to permit the use of ordinary materials of construction.

(6) With the aid of information now being secured, arch dams at some sites may hereafter be built of less thickness than formerly would have been considered necessary.

(7) Economic benefits may be expected, therefore, in lower costs of some dams. For some projects this reduction in cost may be sufficient to make financing possible, thus permitting the creation of productive properties which otherwise would be impracticable.

(8) Dependable means for determining the safety of proposed arch dams will make it possible for regulatory authorities to approve less costly designs than would now be demanded for some sites.

Literature.

A History of Railways in Ireland. By J. C. CONROY. London: Longmans, Green and Co., Ltd,, Paternoster-row, E.C. 4. 1928. Price 15s. net.

THE railways of Ireland are historically of great interest; the first was sanctioned in 1831—the year after the Liverpool and Manchester was opened—they had their gauge troubles, but came off better than did the British as they obtained an extra 6½in., and nearly had a gauge of 6ft. 2in.; the atmospheric system was tried between Kingstown and Dalkey, and the first electrically-operated railway in the Kingdom was at Bushmills. From the first, at least as long ago as 1836, it was recognised that State aid for railway construction was necessary, and in 1839 a vote for 2½ millions was sanctioned by the House of Commons, but the proposal was dropped before the grant was completed. In 1849, however, the British Government lent half-a-million to the Midland Great Western Company to finish its railway. On three occasions Irish railway policy has been the subject of important inquiries, the second and third of which were respectively presided over by men who, in their day, had no superiors in ability or railway experience.—Sir James Allport in 1888, and Sir Charles Scotter in 1906. Furthermore, the Devonshire Royal Commission of 1868 dealt with Irish railways, amongst those of the United Kingdom generally. That Commission said that if, as was proposed, rates in Ireland were fixed on the same level as those in Belgium, there would forthwith be a loss of £646,000 a year, but possible economies, one of which was concentration of management, which alone would save £32,000 per annum, would gradually reduce the loss, and in eleven years the railways would be self-supporting. The Allport Commission also advocated concentration. Little, however, was done except that the Great Southern and Western absorbed two or three small lines, partly to establish itself more firmly against the Dublin, Wicklow and Wexford, and partly in connection with the Fishguard and Rosslare scheme. Thus, when the Scotter Commission was appointed in 1906, it was found that though there were only 3400 miles of railway, they were owned by twenty-nine different companies, and required no less than 261 directors to administer them. What was more remarkable still was that the narrow gauge railways, of a total length of 540 miles, were owned by fifteen companies with a combined directorate of 114. The subject, in various forms, was frequently debated in Parliament, but whatever Government was in power, and whatever its politics, it was always defeated for some reason or other. Railways are State-owned in every other part of the Empire, not because such ownership is better but for the good and sufficient reason that capital could not be raised in the country itself. The same conditions prevailed in Ireland, but because that country, then, was an integral part of the United Kingdom, most people opposed Irish railway nationalisation. But, above all, there was the feeling, hard to describe, that Irish grievances as to the railways were only part of the agitation against the Government—that it was all a matter of politics—and that, were a change conceded, other favours would be expected. Thus the matter was allowed to drag on. The majority of the Scotter Commission once more advocated concentration, but all to no purpose, and it was left to the Irish Free State, with the willing co-operation of the railways of the South, to form, in 1924, one large railway company, from which are excepted the two systems which possess property also in the Northern area.

The first inquiry into Irish railway policy was made by what is known as the Drummond Commission, which reported, in 1838, in terms that were so favourably received in Ireland, that public meetings in its support were held, and an address, signed by the bulk of the Irish peers, was presented to the Queen. Many large landowners, Mr. Conroy tells us, offered to make free grants of their land if the Government would undertake the construction of the railways. "But, despite the obvious wish of the Irish people, the Government refused to take any action on the report." Lord George Bentinck, in 1847—the year of the Great Famine—brought forward a Bill to authorise the State to advance sixteen millions for the systematic construction of Irish railways, which was defeated by 331 votes to 119. Later, in the same session, the Government brought forward and carried its own proposals, but it was forced to do so by the distress which then prevailed in Ireland. Lord John Russell said that the proposal was "part of a general system of policy which the House should adopt in the Government of Ireland and only an act of justice to that country."

It cannot, we imagine, be said that the views of the Irish people themselves in that day were extreme. We may take it that the member of Parliament for such a constituency as Galway would be a representative of the opinion of the majority. If so, it will be of interest to hear that in June, 1865, that member proposed State purchase, administration for five years by a Railway Board, which was to be independent of the Government; and a large reduction in fares. At the end of the five years the railways were to be worked for the State by two or three companies. Mr. Gregory, the member in question, expressed the view which, adds Mr. Conroy, was so often reiterated by the Irish members in following years that:—"First, the State shall not lose by the transaction but, as the purchase has been made for Ireland's benefit, Ireland must be responsible for any temporary deficit that may arise. Secondly, that the railways so purchased shall not be managed by the direct action of the State." Mr. Gladstone spoke in that debate and said:—"I know of no boon that could be conferred upon Ireland so comprehensive in its application, so impartial, so free from taint or suspicion of administering to any particular interest or to the views or convenience of any particular class, so far-reaching in its effects upon all classes and conditions of persons without distinction—I know of nothing that would be so universal in its effect as a better development of the railway system of Ireland."

The majority of the Devonshire Royal Commission, reporting in 1867, was opposed to State purchase, "particularly because it was of more importance not to discourage private enterprise and self-reliance in Ireland . . . but as it has been the established policy to assist railways and other public works in Ireland, we recommend that, when Parliament thinks fit to make advances to Irish railway companies, the money should be lent for a fixed period of considerable length so as to enable the company to develop its resources before it is called on for repayment." The minority was composed of Mr. Monsell—afterwards Lord Emly—and Sir Rowland Hill. The former said that the Government had created the present system and was bound to face any difficulties for the purpose of remedying these evils, and he proposed that the Government should buy the Irish railways, consolidate them and lease them to companies for limited terms and upon certain conditions as to rates and accommodation. Sir Rowland Hill proposed the gradual acquisition of the railways by the State. Mr. Conroy says that the Government apparently favoured Sir Rowland Hill's views, and set up a minor Commission of experts to report more in detail. That body showed that:—(1) A saving of £32,000 a year would be effected by concentration of management; (2) a saving of £88,000 would be effected by placing the debenture capital and other borrowed money under Government guarantee; (3) after eleven years the increased traffic receipts would pay all working charges and interest on the capital advanced to meet the losses incurred during the eleven years period for which help would be necessary, and leave a balance in favour of the Exchequer. Nevertheless "No action was taken on these reports, either in the direction of amalgamation or State purchase." In 1871 there was another debate in Parliament, and on that occasion the member for Galway again spoke and said:—"The Irish members did not ask for one penny gratuity—they simply asked the rich and flourishing country to give the aid of their credit to the poor and backward country, to do nothing more, in short, than to extend the same assistance to Ireland as to Canada." Mr. Gladstone was then again in office, and, the author says, "intimated that there was no time for Irish legislation at present and advised the Irish members of Parliament to mature their plans and let the matter drop." We might here observe that, throughout, that great Statesman appeared to favour some reform for the Irish railways, but always found some reason for postponement.

In 1886 there was another Royal Commission, presided over by Sir James Allport, which was to consider Irish matters in general—fisheries, harbours, canals, railways, &c. As to railways it recommemded in 1888, "On the one hand, centralisation in the hands of a single company; and, on the other, an external controlling authority, with powers to inquire into and remedy grievances." An Irish Railway Commission was to control the administration. Again Mr. Conroy records, that "no action was taken on this report, either in the direction of amalgamation or of State purchase."

Coming, at long last, to the present century, we find that, in April, 1901, there was a motion in the Commons which, though defeated, called the following remarkable statement from that broad-minded politician, Mr. George Wyndham, the then Chief Secretary for Ireland:—"I am very glad we have had this debate. The subject is one that deserves the consideration of all the parties in the House. But I cannot disguise the fact that it is interlocked with other economic questions in Ireland—interlocked with the land question, and so long as that is in an unsettled state, so long as we do not get either from the landlords of from the tenants, and much less from both combined, the pressure which we would get in England or Scotland upon other economic questions—it is difficult to make progress."

In several succeeding years Parliament again discussed the subject, and in July, 1906, appointed the Scotter Viceregal Commission. We referred, in our opening remarks above, to what the majority of that body recommended, and how, in 1924, the Free State Government worked out its own salvation, and, as Mr Conroy observes in his concluding chapter, "After a lapse of nearly ninety years a return has been made to the policy advocated by Drummond."

The paper wrapper in which the book is offered says that the work is the first of a series dealing with recent Irish economic history, compiled by the students of University College, Dublin. It is, therefore, due to these young gentlemen, and to Mr. Conroy in particular, as well as to the publishers, that we should say that their efforts have resulted in a very valuable piece of work.

BOOKS RECEIVED.

The Port of Hull Annual, 1928. By H. E. C. Newham. Hull: Trade and Transit Publications, 13, Bishop-lane. Price 3s. 6d. net.

Railways: Their History and Organisation. By Lord Monkswell. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 6d. net.

Distribution of Electricity by Overhead Lines. By W. T. Taylor. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 25s. net.

The Birmingham Exchange Directory of Members, Subscribers and Representatives, 1928. Birmingham: The Birmingham Exchange. Price 2s. 6d. net.

Excavating Machinery as Represented by Power Shovels, Drag Lines and Grabbing Cranes. By W. Barnes. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 42s. net.

The Design, Construction and Maintenance of Docks, Wharves and Piers. By F. M. Du Plat Taylor. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 70s. net.

Proceedings of the International Congress for Testing Materials, Amsterdam, 1927. Two volumes. The Hague: Martinus Nijhoff, Lange Voorhout 9, Holland. Price £2 10s. the two volumes.

SIXTY YEARS AGO.

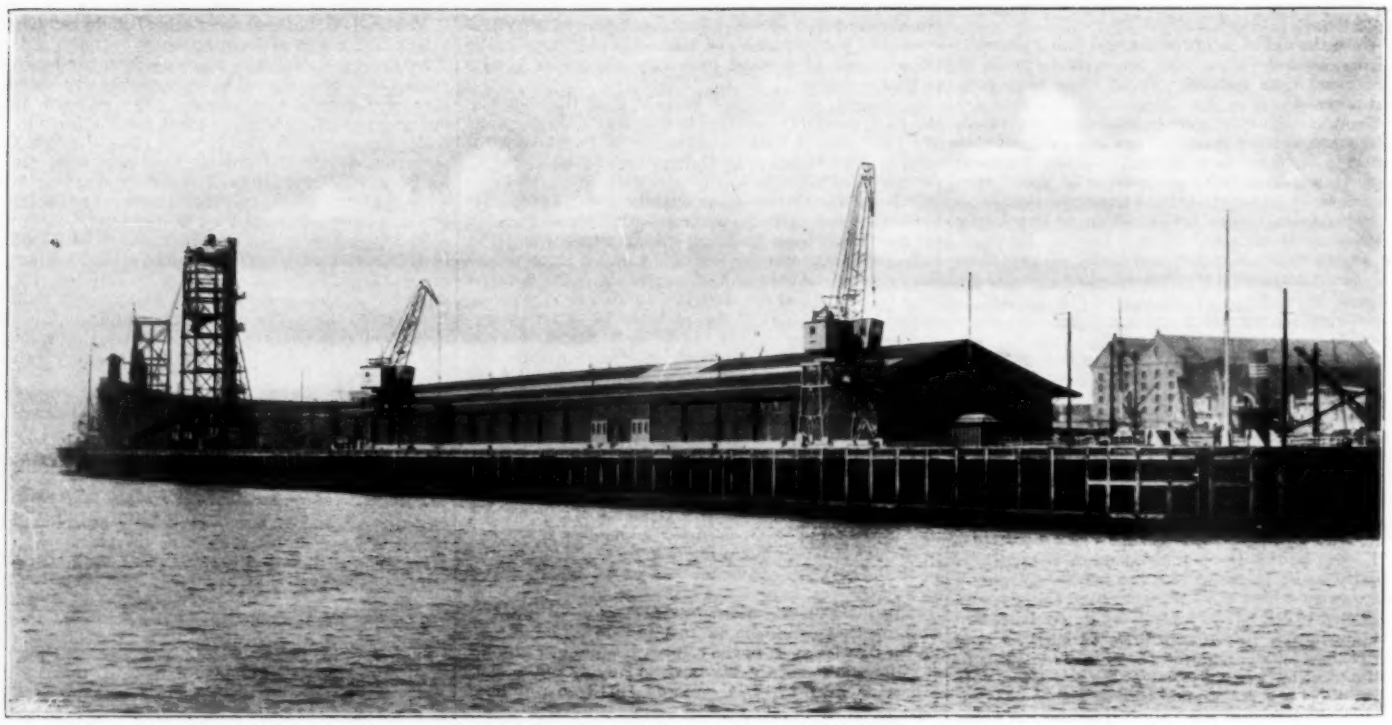
ALTHOUGH Joule's work on the mechanical equivalent of heat was begun in 1843 and was fully reported to the Royal Society in 1849, its significance as establishing what we now refer to as the doctrine of the conservation of energy was, twenty or so years later, still not widely appreciated. Natural philosophy was passing through a difficult period. A revolution had been wrought in its foundations. Many of the old terms, however, still lingered on, and not a few found it hard to follow their new meanings. In our issue of June 21st, 1868, we endeavoured to enlighten our readers regarding the meaning of the conservation of energy. With our explanation a modern critic could find little fault either on the score of its accuracy or lucidity. Allowances have, of course, to be made for the looseness of definition which still marked scientific phraseology. The title of the article was, for instance, "The Conservation of Force," and throughout the article we repeatedly used the term force where now we would use energy. But there was no dubiety in our meaning. We made it quite clear that by force we meant energy, or *vis viva* as it was currently called. The *vis viva* of moving bodies was, we explained, equivalent to work, and our object was to show that heat, electricity, magnetism, sound, light and chemical action were all of the nature of *vis viva*, and were all equivalent to work. We were apparently put to some necessity to explain on the basis of Joule's equivalent why the steam engine was so inordinately inefficient. Taking that equivalent at 772 and the calorific value of a pound of coal at 15,000, we calculated that the work equivalent to the heat produced by burning 1 lb. of coal was over 11¼ million foot-pounds. That figure, we said, would appear astoundingly high to those who knew that there were only 33,000 foot-pounds in a horse-power exerted for one minute. We sought to palliate it by referring to the imperfections of furnaces and engines, and, somewhat obscurely, by a reference to the loss sustained "in tearing asunder the particles of water to form steam." To those losses we added, in a passage of much lucidity, that incurred in accordance with the second law of thermodynamics. Only at one point throughout our discussion did we fall into anything like a serious mistake. In, no doubt, an access of enthusiasm for the new "law," we were led into saying that the work spent in pulverising coal or in reducing wood to the form of sawdust or shavings would be recovered in the increased heat which those fuels would yield on combustion. We commended that deducton to the attention of the advocates of liquid fuel, presumably in order that they might use it to advantage by subdividing their oil at the burners to the finest possible degree. It is interesting to speculate what problems would arise and what problems now facing us would be solved were our deduction scientifically sound.

THE Government of Ecuador requires two electrically operated portal cranes, one of 5 tons and the other of 10 tons capacity. Tenders should be submitted by July 31st.

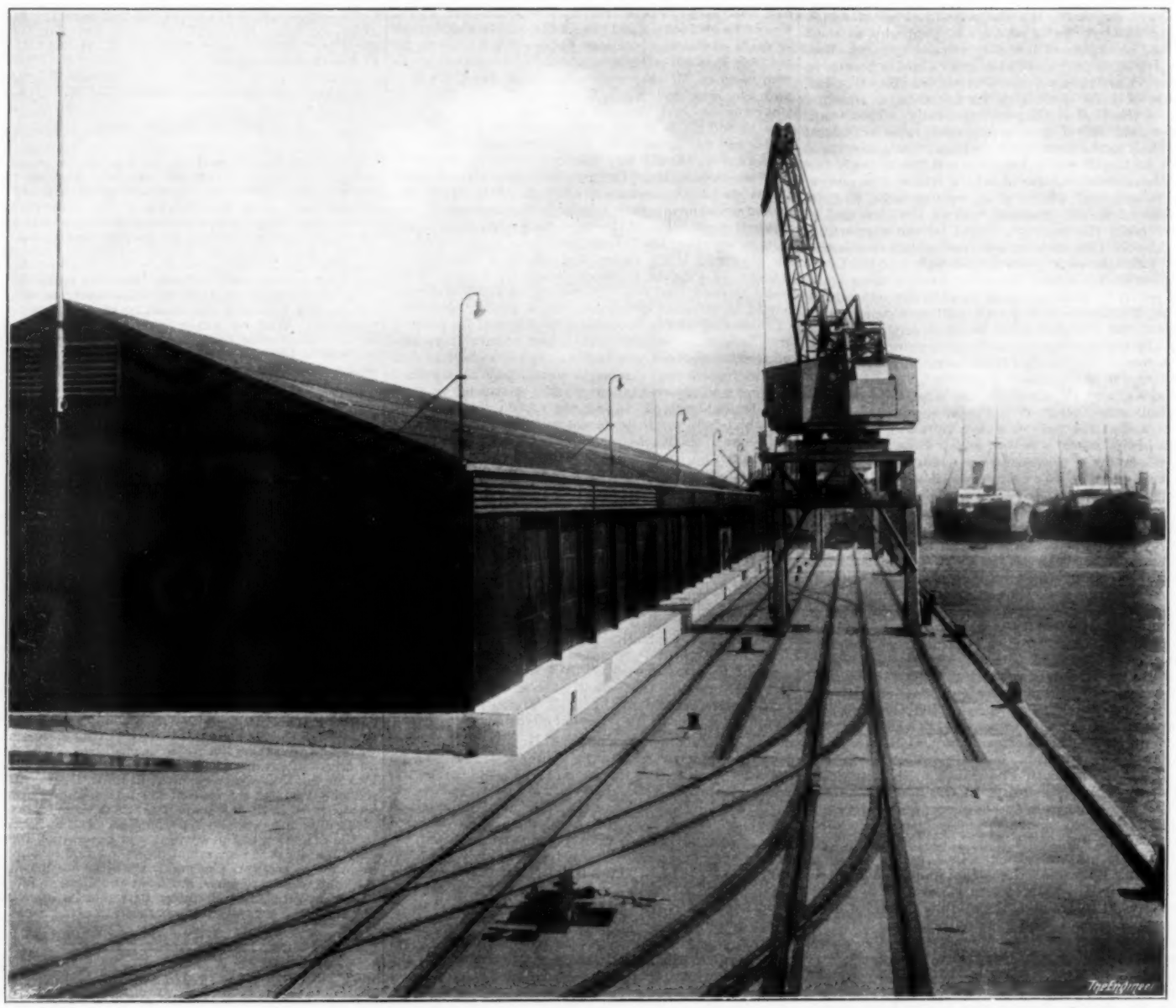
NEW RIVERSIDE QUAY ON THE TYNE

MR. R. F. HINDMARSH, M. INST. C.E., NEWCASTLE-UPON-TYNE, ENGINEER

(*For description see opposite page*)



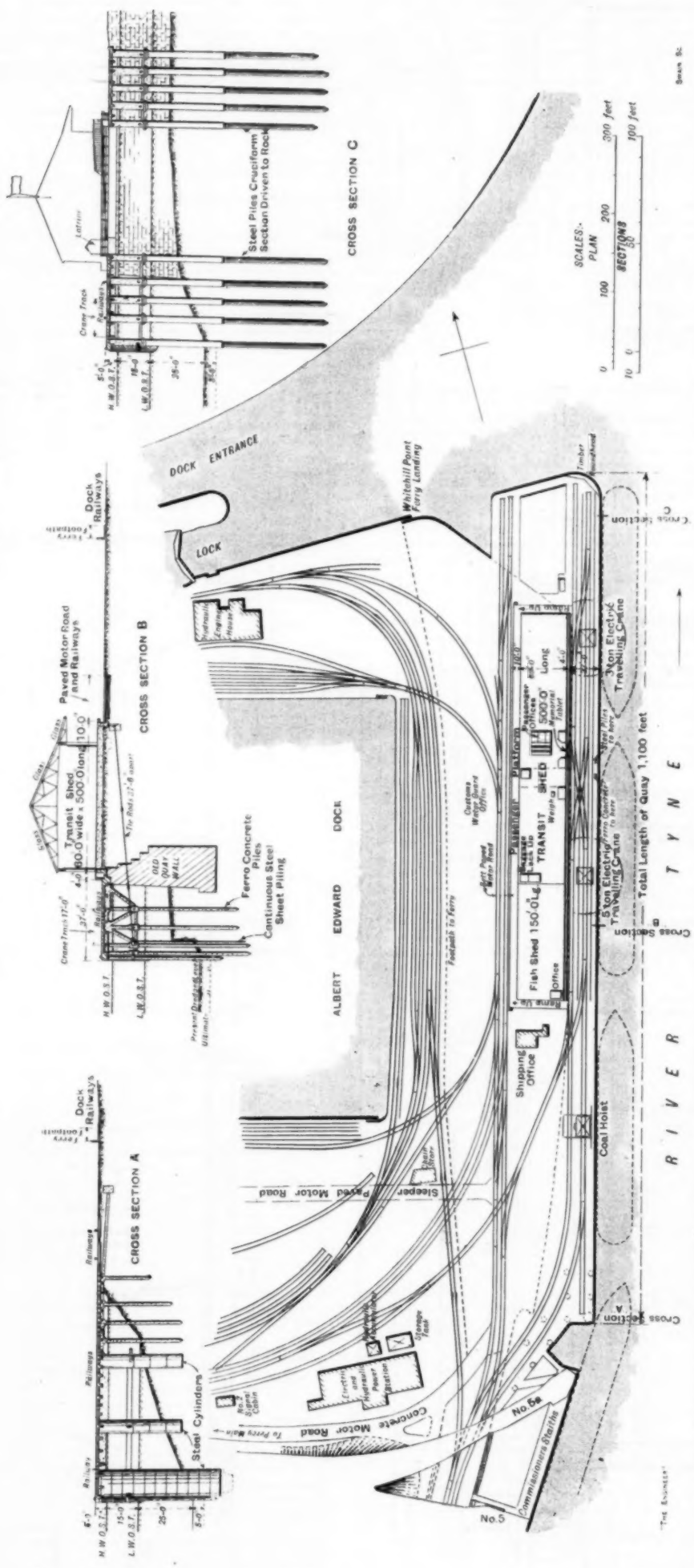
GENERAL VIEW OF THE QUAY FROM THE RIVER



VIEW ALONG THE QUAY SHOWING SHEDS, RAILWAY LINES AND CRANES

NEW RIVERSIDE QUAY AT THE ALBERT EDWARD DOCK ON THE TYNE

MR. R. F. HINDMARSH, M. Inst. C.E., NEWCASTLE-UPON-TYNE, ENGINEER



New Quay at the Albert Edward Dock on the Tyne.

TO-DAY a new deep-water riverside quay, which has been built at the Albert Edward Dock by the Tyne Improvement Commission, was formally put into service by Sir William J. Noble, Bart., the Chairman of the Commission. There has thus been added another to the long list of the "improvements" which the Commission was specially set up to devise and carry out. It is just seventy-eight years since by Act of Parliament the River Tyne was put into its charge. During that period an almost incredible amelioration has been brought about in the River. In 1850, by reason of a bar at the mouth, and silting in the lower reaches, it was impossible for any vessels but those of very shallow draught to proceed up the river. That fact had retarded the growth of the coal trade of Northumberland and Durham. But very soon there was a change. The bar was removed by dredging; two breakwaters were built at the entrance; the river was deepened; islands were removed; projecting points were cut off, and now it is claimed for the 19 miles of river which are controlled by the Commission that they form *one huge dock*. And, indeed, they are lined with wet docks, quays, coal shipping staiths, shipyards, dry docks, factories and arsenals. More than twenty years ago developments had proceeded far enough to permit of the building of the "Mauretania," a vessel of over 30,000 tons, drawing 36ft. and more of water, and last year the latest battleship—the "Nelson"—which is 710ft. long by 106ft. beam and draws 30ft. of water, was constructed on, and successfully taken down, the River. Moreover, the largest floating docks in the world are Tyne-built structures. So the Commission has good cause to be proud of what it has done.

The new quay is situated on the river front of the Albert Edward Dock, which was opened by the late King Edward, when Prince of Wales, some forty-four years ago. It is only two miles from the open sea. The river frontage formerly consisted of a concrete quay wall with a maximum depth obtainable alongside of about 14ft. at low water of ordinary spring tides. Alongside the new quay, which is 1100ft. in length, dredging has been carried out to 25ft. at low water of ordinary spring tides, and provision has been made for an ultimate depth of 30ft. at low water of ordinary spring tides.

The Quay is illustrated on page 664, and drawings of it are given herewith. The first step in its construction was to drive sheet piling along nearly the whole length of the old quay, and to tie the sheet piling back, at frequent intervals, to anchor blocks placed under the passenger platform of the transit shed. It was then that the dredging to 25ft. at low water of spring tides was carried out. The bed of the river on which the new Quay is constructed is of a varied nature; at the south end it consists of sandstone, and at the north end of soft mud. This variation of strata necessitated the adoption of different methods of construction. Three different types were employed. First of all, at the south, or downstream, end, the Quay was built on steel cylinders, varying in diameter from 6ft. to 13ft., which were sunk under compressed air, founded on rock and filled with concrete. This construction is seen in the cross section A in the accompanying engraving. The centre portion of the Quay is carried on reinforced concrete piles, arranged in the manner shown on the cross section B. In this drawing it will be observed that the old quay wall has been allowed to remain in position, the new quay being built to riverward of it.

At the north end, where the soft material extends down to a depth of some 80ft. or so below low water of ordinary spring tides, cruciform steel piles ranging in length up to 90ft. were used. They were driven down to rock and their top parts were encased in steel tubes filled with concrete. The arrangement is seen in the cross section C on the drawing. The superstructure of the Quay throughout is of reinforced concrete, except at the north-east end, where timber has been used for fendering purposes.

The general lay-out of the Quay is well shown on the drawing, and does not call for detailed description. A single storey transit shed, 500ft. long and 60ft. wide, is situated about 41ft. from the Quay face. It contains passenger and Customs offices and a railway platform, so that passengers may be conveyed by train between the Quay and any part of the railway systems of the country. For that purpose the railway lines have been relaid and extended and a new system of signalling installed in order to meet the requirements of the Ministry of Transport and of the London and North-Eastern Railway Company. At the seaward end of the Transit Shed there has been built a new fish shed, 150ft. long.

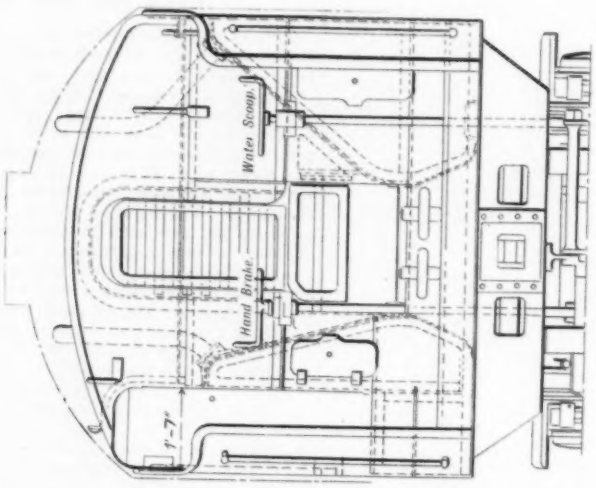
On the Quay front are laid two lines of railway and crane track on which two electric cranes—one 3-ton and one 5-ton—can operate. A view along the Quay front is given in the lower view on page 664, the upper engraving being a view of the quay front as seen from the river. An hydraulic hoist, which is designed to lift 20-ton coal wagons and deliver their contents into ships at a height of 65ft. above high water of ordinary spring tides, at a speed of 500 tons per hour, has also been erected.

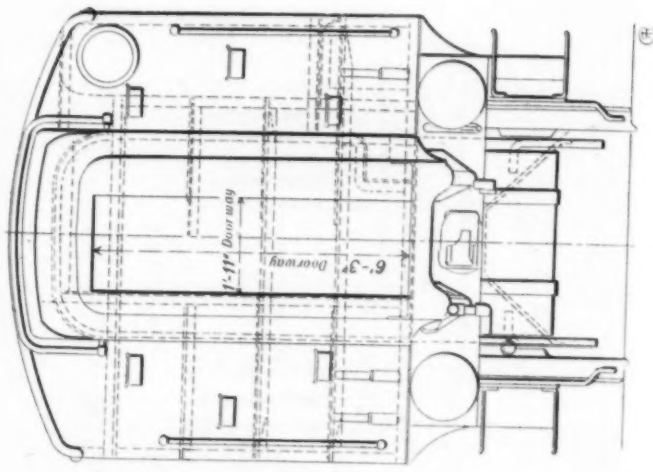
Hitherto, the hydraulic power used on the Commissioner's Dock Estate has been generated by steam-

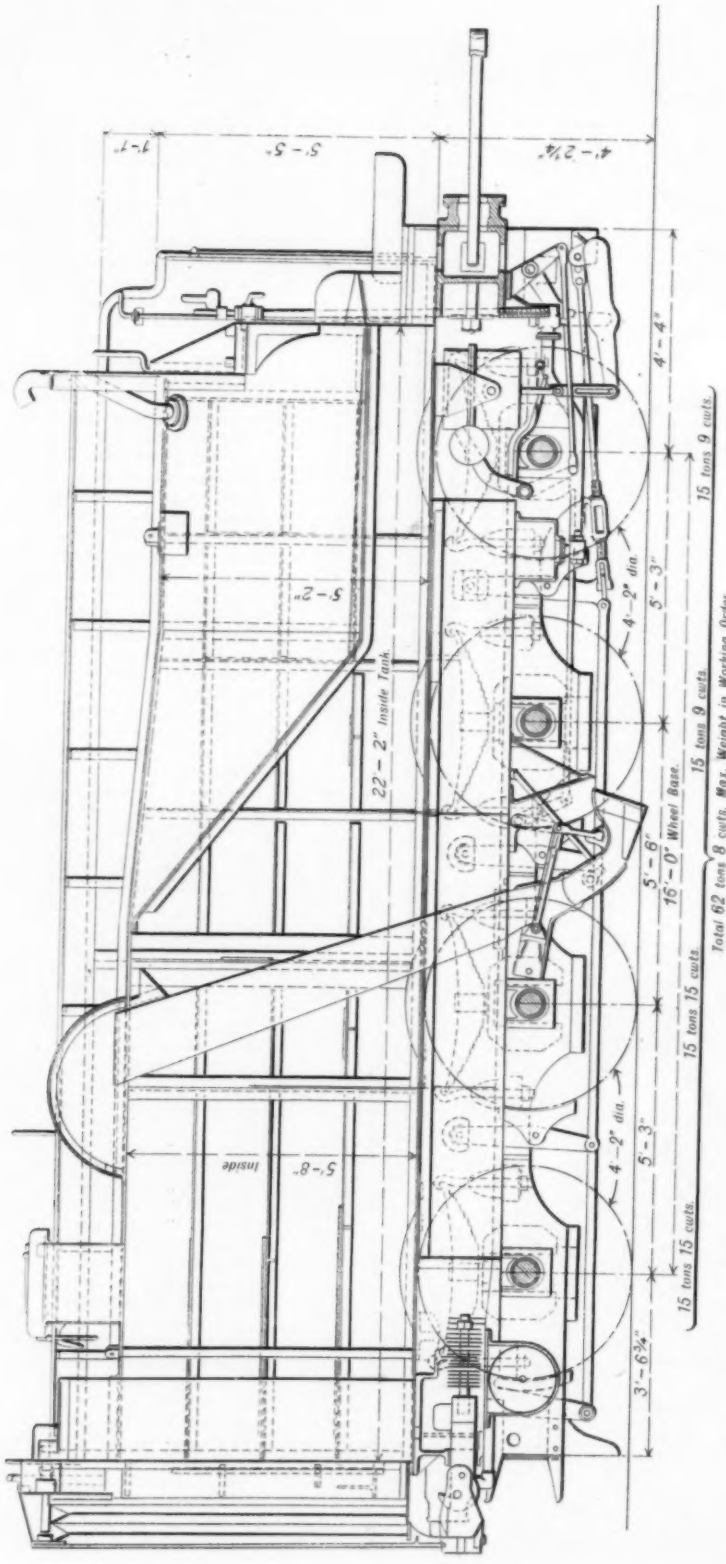
L. AND N. E. RAILWAY—CORRIDOR TENDER

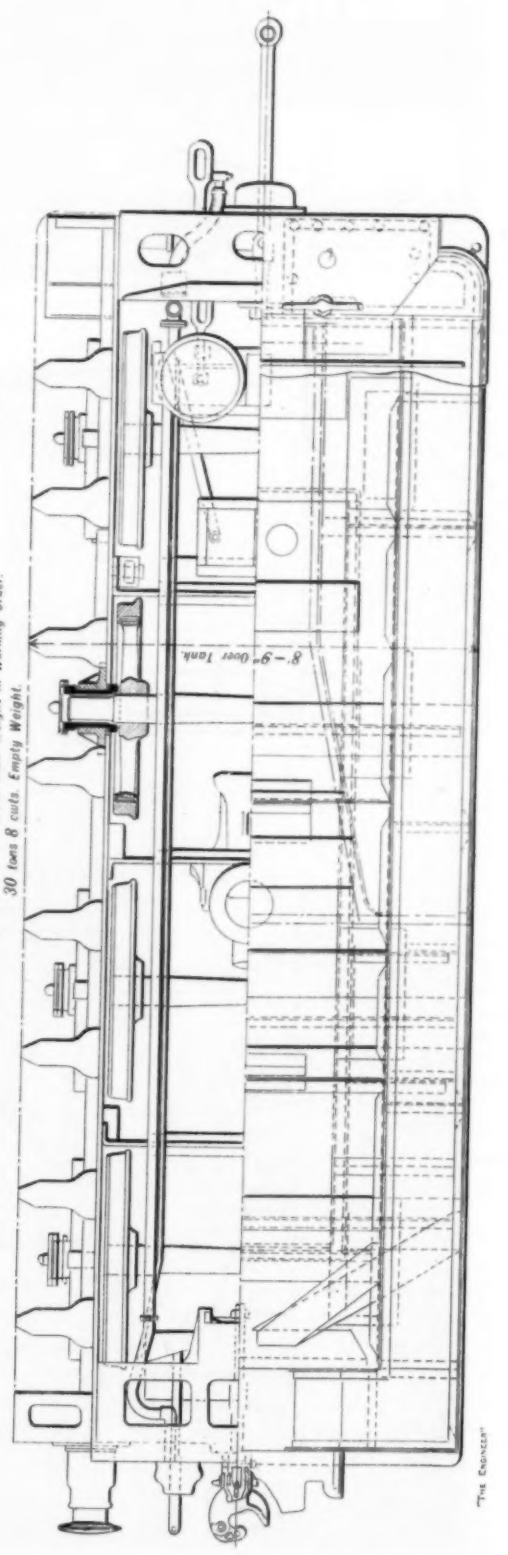
MR. H. N. GRESLEY, M. INST. C.E., LONDON, ENGINEER

(For description see opposite page)









THE ENGINEER

driven plant situate near the Albert Edward Dock entrance. As part of the new works, however, the Commissioners have constructed a new electric sub-station and power house at the south end of the Quay. A bulk supply of three-phase electric current is taken from the Tynemouth Corporation. The current is received at a pressure of 6000 volts, which is stepped down to 440 volts, alternating, for hydraulic pumping. A portion of the energy is also converted to direct current at 480 and 240 volts for power and lighting. In the sub-station there are four electrically driven automatically controlled hydraulic pumps, which supply hydraulic power over the whole of the Dock Estate, and there is provision for the installation of two additional pumps.

When it was first established the steamship service between the Tyne and Norway was carried on from the Albert Edward Dock. Subsequently, it was transferred to Newcastle Quay, but with the completion of the new Quay it is again to go back to the Albert Edward Dock. It is interesting from an historical point of view that the first vessel, the "Bergen," built for the Bergenske Steamship Company, Ltd., sailed from the Tyne in November, 1852, just after the Commission had received its statutory powers. The service has been since continued. In 1885 there were weekly sailings, and in 1893 a bi-weekly service was instituted, and at the present time three sailings a week are maintained in the winter, and there are four sailings weekly during the summer. The traffic comprises tourists, mails, general cargo and coal cargoes. It is intended that passengers shall be conveyed from, say, King's Cross, and deposited right alongside the steamer. Tourists travelling by road instead of by train have also been provided for, there being extensive parking accommodation for motor cars.

We may add, in conclusion, that the works of the new Quay and station were carried out to the designs of Mr. R. F. Hindmarsh, Engineer to the Commission. The contractors for the Quay works were Brims and Co., Ltd., and for the buildings Wm. Hall (Contractors), Ltd., and Benjamin Peel, Ltd. The electric cranes were supplied by Babcock and Wilcox, Ltd., and the coal hoist and capstans by Vickers-Armstrongs, Ltd. The power-house machinery was installed by the English Electric Company, Ltd., and the signalling apparatus by the Westinghouse Brake and Saxby Signal Company, Ltd. A new road was constructed by Holloway Brothers, Ltd.

L. and N.E. Rly.—Corridor Tender.

IN order to provide for the change of the engine-crew on the London and North-Eastern Railway non-stop run to Edinburgh, Mr. H. N. Gresley has designed a special tender provided with a corridor, by which the men can gain access to a compartment reserved for them immediately behind the tender. On the opposite page we give a drawing of this tender, which speaks for itself. The corridor passes down the right-hand side of the tender, turns to the left, and opens through a doorway in the centre of the back, which leads through an ordinary Pullman vestibule to the adjacent compartment. The standard Buckeye coupling is used. The tender carries 9 tons of coal and 5000 gallons of water.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RUBBER IN BRIDGE CONSTRUCTION.

SIR,—Timber-decked bridges are practically unknown nowadays in Great Britain, but in many parts of the Empire and Protectorates they are still common enough, and every engineer who has had to build them knows the trouble that arises from the noise and rattle that soon make themselves evident, to say nothing of the rapid deterioration of the decking planks and girders, when the latter are also of timber; that occurs owing to the timber becoming "nail sick."

The writer had to build a steel bridge that had been designed for timber decking across a river in the Malay States. The total length was 300ft., and as an experiment it was decided to place a strip of rubber between the planks and the steel girders. A local rubber planter undertook to make the strips, which were of pure "Blanket" rubber, ¼in. thick and 8in. wide, the width of the top flange of the girders, and, of course, the rubber was not vulcanised.

The rubber was laid over the two central girders only and the decking secured to the outside girders. This had the effect of keeping the rubber in compression and giving an imperceptible camber to the decking. The bridge was opened on August 1st, 1922, and some years afterwards a visitor to the country described it as "The silent bridge."

At the end of 1926 it had not been necessary to renew a single plank, and no rattle whatever had occurred, and the rubber appeared as good as the day it was put down. The economy thus effected was very great. Ordinary bridges with timber decking under the most favourable conditions commence to rattle after a few months, renewals have to be made often within a year, and cases have been known where it has been necessary to renew the entire decking and some of the girders in three years.

The bridge was very largely used, the traffic crossing it amounting to several hundred motor cars and lorries per diem, in addition to a great number of bullock carts. It was soon recognised that the rubber was a great success, and the writer used it in many other cases, where the whole structure was of timber, as well as when plank decking was laid on steel girders, as in the case described above. A particular case occurred when a new road through uncleared jungle was under construction. A type of light bridge was designed with concrete piles, steel girders and locally obtained plank decking. The locality had a heavy rainfall, but both the timber and the rubber strips were in excellent order after two years. Of course, an important point was not to pierce the rubber. The decking was therefore secured by bolts with lugs under the flanges of the steel girders.

Pure unvulcanised rubber, ¼in. thick, weighing about 2 lb. 6 oz. per square foot, can be obtained in the United Kingdom cut to such widths as may be required. The cost would probably be about 9d. a pound over the standard price of rubber, but competitive tenders for large quantities would probably lead to lower prices.

W. ROGER SANGUINETH,
Late State Engineer, Kedal,
Malay States.

June 9th.

MULTIPLICATION WITH A DIFFERENCE.

SIR,—An old rhyme with which most of us were well acquainted in our early school-days had for its first line "Multiplication is vexation," and the majority of us agreed entirely with the sentiment so expressed. After much tribulation we reached the twelve times table, and there we rested on our laurels. Twelve times twelve was the pinnacle of our mental achievement in arithmetic. If the metric system had been in vogue, it is safe to say that ten times ten would have represented our zenith. We learned to do sums on paper or on our slates, and did them in a certain prescribed manner, and having got into a particular groove, have remained in that groove ever since.

In an endeavour to get out of the groove in which the wheels of the multiplication chariot run, I discovered a system by which most multiplication sums may be solved in one line. Having fully realised how much cleverness exists and has existed in this world, I make haste to add that this method has probably been discovered before, like most good things. Be that as it may, with all becoming modesty, I must here state that so far as my knowledge goes, my system is original. It was given birth by means of a little elementary algebra, a little time, a modicum of patience, and a lot of luck.

It is quite evident to me at this stage that what follows may appear involved, but it is in reality quite simple once the method is grasped. The method may be compared to the building of a house by the process of laying brick upon brick, the sequence being quite regular. By following the method closely and with a little practice, calculators of average ability should be able easily and quickly to negotiate the multiplication of two numbers, each of them being below a maximum of one thousand; that is to say, consisting of three digits. Calculators of slightly more than average ability should have no difficulty in multiplying two numbers, each consisting of four, five or even more digits; the answer embracing nine, ten or more digits. Here follows the method, and I sincerely hope I can make it clear to you:—

First, the examples:—

(1) 123×456.
(2) $32{,}654 \times 89{,}701$.

Next, the examples worked out according to all established precepts:—

(1)		(2)	
	123		32,654
	456		89,701
	738		32,654
	615		22857,80
	492		293886
			261232
	56,088		2,929,096,454

And the new method. You must note here that in each example the digits chosen are all different in order to help the explanation.

123
456
56,088

Begin from the right and put the answer down from the right.

(1) $6 \times 3 = 18$, put down 8, carry 1.
(2) $6 \times 2 = 12$, add $5 \times 3 = 15$, add 1 carried from the first stage.
Total 28. Put down 8, carry 2.
(3) $6 \times 1 = 6$, add $3 \times 4 = 12$, add $2 \times 5 = 10$, add 2 carried from second stage.
Total 30. Put down 0, carry 3.
(4) $5 \times 1 = 5$, add $4 \times 2 = 8$, add 3 carried from third stage.
Total 16. Put down 6, carry 1.
(5) $4 \times 1 = 4$, add 1 carried from the fourth stage $= 5$.

If you have faithfully followed these instructions, you will now have put down the complete answer, and can start on the second example, thus:—

32,654
89,701
2,929,096,454

(1) $1 \times 4 = 4$. Put down at right-hand side.
(2) $(1 \times 5) + (4 \times 0) = 5$. Second figure in answer.
(3) $(1 \times 6) + (4 \times 7) + (5 \times 0) = 34$. Put down 4, carry 3.
(4) $(1 \times 2) + (9 \times 4) + (6 \times 0) + (5 \times 7) + 3 = 76$. Put down 6, carry 7.
(5) $(1 \times 3) + (8 \times 4) + (9 \times 5) + (2 \times 0) + (6 \times 7) + 7 = 129$. Put down 9, carry 12.
(6) $(3 \times 0) + (5 \times 8) + (2 \times 7) + (6 \times 9) + 12 = 120$. Put down 0, carry 12.
(7) $(7 \times 3) + (8 \times 6) + (9 \times 2) + 12 = 99$. Put down 9, carry 9.
(8) $(9 \times 3) + (8 \times 2) + 9 = 52$. Put down 2, carry 5.
(9) $(8 \times 3) + 5 = 29$. Put this figure down at the left-hand side.

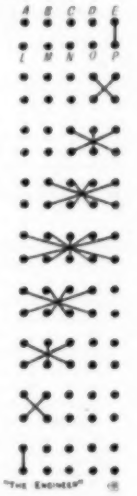
To explain further:—

Represent the sum by symbols—

A B C D E × L M N O P, thus—
A B C D E
L M N O P

9,8,7,6,5,4,3,2,1 representing the answer.

(1) E.P .. ..
(2) O.E + D.P .. ..
(3) C.P + E.N + D.O .. .. ..
(4) B.P + E.M + C.O + D.N ..
(5) A.P + E.L + B.O + D.M + C.N
(6) A.O + D.L + B.N + C.M ..
(7) A.N + C.L + B.M .. .. ..
(8) A.M + B.L .. ..
(9) A.L .. ..



In every case care must be taken to add the carried figure to the following stage, where the sum total of any stage consists of more than one digit. The dot between each pair of symbols in the above stages represents the multiplication sign.

Where the figures to be multiplied do not consist of the same number of digits, 0 may be substituted for each missing digit, thus:—

$$15{,}273 \times 161 = 15{,}273 \times 00{,}161.$$

When fully acquainted with the method, the zeros may be dispensed with.

By this time the casual reader is possibly aghast, and will emphasise the vexation as allied to multiplication, but take courage, practise the examples, substitute other examples of your own, and you will soon master the method. It appears difficult, but it is really very simple. It is, after all, only a mental game of chess, and practice will make perfect. The time taken for each example will soon become extremely short when proficiency is attained.

HAROLD I. SIDGWICK.

Golders Green, N.W. 11, May 24th.

MANCHESTER ELECTRICITY SUPPLY.

THE annual report and accounts of the Electricity Committee of the Manchester City Council for the year ended March 31st last show that the total income of the department amounted to £1,604,167; the working expenditure, exclusive of depreciation, £864,417; the interest, sinking fund and income tax, £628,808; leaving a net balance of £110,942, compared with £40,659 for the previous year. The total outlay of the department now reaches £9,944,355; the increase being partly on the extensions at Barton Generating Station, and the remainder in distribution and consuming devices. The loan debt stands at £5,368,329. The increase in the volume of business amounts to 9·3 per cent., the annual sales totalling 353,492 million kilowatt-hours. The average price of fuel fell from 344d. per ton—the level of the preceding year, when the dispute in the coal trade existed—to 178d. per ton. The consumption totalled 323,798 tons, and the average weight of fuel consumed per kilowatt-hour of electricity sold was 2·05 lb., as compared with 2·02 lb. in the previous year.

In spite of considerable delay caused by the exceptionally wet weather of last winter, the extension of the Barton Station has proceeded satisfactorily. The buildings and structural steelwork are practically complete, and erection of the new 40,000 kW turbo-alternator is in progress. Of the three new boilers which are being installed, the first—which is equipped for burning pulverised fuel—is almost complete, and the erection of the two stoker-fired units is well advanced.

Extensions to the 33,000-volt switchgear in the old

COMPARATIVE TESTS OF LOCOMOTIVES WITH 180 AND 220 LB. PRESSURE

TABLE I.—*Dynamometer Car Tests, L.N.E.R. "Pacific" Engine No. 4473, Pressure 180 lb.*

Road	Doncaster to King's Cross and return.	Doncaster to King's Cross and return	Doncaster to King's Cross and return.	Doncaster to King's Cross and return.	Doncaster to King's Cross and return.	Doncaster to King's Cross and return.
Date	13–2–28.	14–2–28.	15–2–28.	16–2–28.	17–2–28.	18–2–28.
Trip	1	2	3	4	5	6
Weight behind tender, tons	(a) 427·0 (b) 495·25 (c) 334·25	(a) 430·5 (b) 495·75 (c) 327·75	(a) 425·5 (b) 494·25 (c) 333·25	(a) 439·75 (b) 488·75 (c) 331·75	(a) 432·25 (b) 488·25 (c) 332·25	(a) 456·25 (b) 489·75 (c) 333·75
Total weight of train including engine, tons	(a) 567·0 (b) 635·25 (c) 474·25	(a) 570·5 (b) 635·75 (c) 467·75	(a) 565·5 (b) 634·25 (c) 473·25	(a) 579·75 (b) 628·75 (c) 471·25	(a) 572·25 (b) 628·25 (c) 472·25	(a) 596·25 (b) 629·75 (c) 473·75
Coal per mile, lb.	40·1	34·95	37·93	40·65	40·61	38·76
Coal per D.B.H.P. hour, lb.	3·44	3·09	2·89	2·99	3·06	3·00
Coal per ton-mile, lb.	0·072	0·062	0·068	0·072	0·072	0·068
Coal per sq. ft. of grate area per hour, lb.	50·43	44·13	47·73	51·63	52·82	51·0
Water, lb. per lb. of coal, lb.	7·97	8·11	8·3	8·46	7·95	8·3
Water per D.B.H.P. hour, lb.	27·9 26·9	24·7 25·4	23·8 24·2	24·3 26·4	23·8 24·9	21·4 25·5
Gallons per mile	31·65 32·2	28·75 27·9	32·5 30·5	33·7 35·0	31·6 32·8	31·8 32·5
Average speed, m.p.h.	54·9 49·2	54·8 49·7	53·3 50·65	54·83 50·22	56·08 51·6	55·7 53·0
Work done in H.P. hours	1766·8 1867·0	1816·0 1712·6	2125·3 1958·5	2164·6 2070·3	2078·1 2059·6	2034·6 1987·5

NOTE.—Coal per ton-mile includes weight of engine, but excludes coal used for shed duties. Rossington coal used throughout. Boiler pressure 180 lb. per square inch.
(a) Doncaster to King's Cross; (b) King's Cross to Peterborough; (c) Peterborough to Doncaster.

TABLE II.—*Dynamometer Car Tests, L.N.E.R. "Pacific" Engine No. 2544, Pressure 220 lb.*

Road	Doncaster to King's Cross and return.	Doncaster to King's Cross and return.	Doncaster to King's Cross and return.	Doncaster to King's Cross and return.	Doncaster to King's Cross and return.
Date	20–2–28.	21–2–28.	22–2–28.	23–2–28.	24–2–28.
Trip	1	2	3	4	5
Weight behind tender, tons	(a) 433·75 (b) 506·75 (c) 348·75	(a) 428·75 (b) 508·25 (c) 347·25	(a) 424·75 (b) 505·75 (c) 346·75	(a) 427·75 (b) 502·25 (c) 346·25	(a) 428·75 (b) 512·25 (c) 355·25
Total weight of train including engine, tons	(a) 577·75 (b) 650·75 (c) 492·75	(a) 572·75 (b) 652·25 (c) 491·25	(a) 568·75 (b) 649·75 (c) 490·75	(a) 571·75 (b) 646·25 (c) 490·25	(a) 572·75 (b) 656·25 (c) 499·25
Coal per mile, lb.	37·18	35·89	35·4	34·39	34·01
Coal per D.B.H.P. hour, lb.	3·27	3·17	3·24	2·92	2·99
Coal per ton-mile, lb.	0·065	0·063	0·062	0·060	0·059
Coal per sq. ft. of grate area per hour, lb.	49·6	47·92	46·8	45·4	44·32
Water, lb. per lb. of coal, lb.	7·67	7·82	8·32	8·75	8·31
Water per D.B.H.P. hour, lb.	24·35 25·81	24·18 25·51	25·53 28·52	25·91 25·15	23·9 25·76
Gallons per mile	28·7 28·3	28·9 27·18	28·58 30·38	28·76 31·42	27·22 29·28
Average speed, m.p.h.	58·3 52·16	57·18 53·3	57·5 51·8	55·55 53·5	55·7 51·93
Work done in H.P. hours	1837·0 1709·8	1862·8 1658·5	1745·5 1660·7	1729·3 1947·6	1775·1 1773·8

NOTE.—Coal per ton-mile includes weight of engine, but excludes coal used for shed duties. Rossington coal used throughout. Boiler pressure 220 lb. per square inch.
(a) Doncaster to King's Cross. (b) King's Cross to Peterborough. (c) Peterborough to Doncaster.

TABLE III.—*Trial with L.N.E.R. "Pacific" Type Locomotives—Summary. February 13th to 24th, 1928.*

	Lb. per mile.	Lb. per ton-mile train and engine.	Lb. per D.B.H.P.	Weight of train behind tender in tons.			Average speed, m.p.h.	
				Doncaster to King's Cross.	King's Cross to Peterborough.	Peterborough to Doncaster.	Doncaster to King's Cross.	King's Cross to Doncaster.
Engine No. 4473, 180 lb. pressure:								
Trip No. 1, Doncaster to King's Cross and return	40·1	·072	3·44	427	495	334	54·9	49·2
Trip No. 2, Doncaster to King's Cross and return	34·95	·062	3·09	430	495	327	54·8	49·7
Trip No. 3, Doncaster to King's Cross and return	37·93	·068	2·89	425	494	333	53·3	50·65
Trip No. 4, Doncaster to King's Cross and return	40·65	·072	2·99	439	488	331	54·83	50·22
Trip No. 5, Doncaster to King's Cross and return	40·61	·072	3·06	432	488	332	56·08	51·6
Trip No. 6, Doncaster to King's Cross and return	38·76	·068	3·00	456	489	333	55·7	53·0
Average	38·83	·069	3·08	435	491	331	54·93	50·73
Engine No. 2544, 220 lb. pressure:								
Trip No. 1, Doncaster to King's Cross and return	37·18	·065	3·27	433	506	348	58·3	52·16
Trip No. 2, Doncaster to King's Cross and return	35·89	·063	3·17	428	508	347	57·18	53·3
Trip No. 3, Doncaster to King's Cross and return	35·4	·062	3·24	424	505	346	57·5	51·8
Trip No. 4, Doncaster to King's Cross and return	34·39	·060	2·92	427	502	346	55·55	53·5
Trip No. 5, Doncaster to King's Cross and return	34·01	·059	2·99	428	512	355	55·7	51·93
Average	35·37	·062	3·12	428	506	348	56·84	52·54

Rossington coal used on all above tests. Coal per ton-mile excludes coal used for shed duties.

IN our report of the discussion on a paper presented at the "Civils" Centenary Conference by Sir Henry Fowler and Mr. Gresley, reference is made to some recent tests carried out on the L. and N.E. Railway by Mr. Gresley. The results obtained are of such importance that we give herewith a full account of them.

The object of the test was to ascertain what saving, if any, would result from increasing the boiler pressure from 180 lb. to 220 lb. Two "Pacific" engines were used. Engine 4473 is a standard "Pacific" locomotive having three cylinders just over 20in. diameter by 26in. stroke; the piston valves have a travel of 5¾in., the lap is 1⅜in., and the lead ⅛in. This engine has a tractive power of 30,362 lb. No. 2544 has three cylinders, 18½in. diameter by 26in. stroke; the valves have a travel of 5¾in., the lap is 1⅜in., and the lead ⅛in.; the tractive power is 30,362 lb. This engine differs from No. 4473 in its boiler, which is designed for the higher pressure of 220 lb.

The tests were carried out between King's Cross and Doncaster. The engines worked the passenger train leaving Doncaster at 11.4 a.m. and arriving at King's Cross at 1.55 p.m., and worked back to Doncaster, leaving King's Cross at 4 p.m., arriving at Doncaster at 7.15 p.m. The load in all cases includes that of the company's dynamometer car.

The engines were worked by Doncaster men. Coal was weighed on to the tender and off after each day's running. Coal for lighting up and for use until the engine was on its train was weighed separately and not included in the figures given in the table. The tenders were calibrated and the water was measured by a suitable indicator.

The dynamometer car was attached between the engine and train on all trips and full records of the engines' performances were taken.

The trials began on February 13th with 4473 engine, 180 lb. pressure, which made six round trips between Doncaster and King's Cross, and were continued from February 20th to 24th with 2544 engine, 220 lb. pressure.

The weather during the trials with 4473 was not so favourable as during the following week, and consequently that engine exerted on an average 7½ more horse-power than engine 2544. That fact accounts for the higher coal consumption per train mile and per ton-mile, but when the coal consumption is expressed in terms of draw-bar horse-power engine 4473 was slightly more economical than the engine having the 220 lb. boiler.

The tables give full particulars of the trials in question.

switch house have been carried out, and extensions in the new switch house are proceeding. It is expected that the new section of the plant will be ready to go into commission in August next. Plans for the further extension and completion of the Barton Station are at present under consideration. In the Electricity Commissioners' returns for the year 1926–27 of the principal operating statistics for Great Britain, Barton is again placed first for thermal efficiency.

ELECTRICAL EXTENSIONS AT CLACTON.

To meet the increasing demand for electricity in the rural areas and to cope with anticipated additional local demands, Mr. George Broadhurst, the electrical engineer to the Clacton Urban District Council, has installed two additional Diesel engines coupled to 750-kilowatt, 6600-volt, 50-cycle, three-phase alternators. Converting plant and switchgear for controlling the alternating-current supply has also been installed. Previously, the station was entirely a three-wire direct-current station, with a total capacity of 1220 kilowatts, and contained among other plant a 270-kilowatt Crompton-Parkinson dynamo direct coupled to a Carels-Diesel engine. Crompton-Parkinson also supplied a 25-kilowatt three-wire rotary balancer, capable of dealing with an out-of-balance current of 100 ampères with 500 volts across the outers.

The alternating-current is transformed up to 11,000 volts by two 250 kVA three-phase transformers. The converting plant, which has been installed by Crompton-Parkinson, consists of a 500-kilowatt six-phase rotary converter and a 250-kW converter, both designed to give 440/520 volts on the direct-current side. Both rotaries are designed for reactance control and for starting up by means of pony motors from the alternating-current side, and by means of resistance when started on the direct-current side. The machines are self-synchronising, in accordance with the makers' patented starting and synchronising system, which is very simple. The rotaries are suitable for inverted operation, and as a matter of fact they operate in that manner for eighteen hours out of the twenty-four. The switchgear, including the 11,000-volt feeder equipment, was supplied by the same firm, and consists of cubicles of the latest design. In all there are ten cubicles and a two-panel direct-current board equipped with circuit breakers, &c., for the direct-current supply; the starting panels and exciter pillars are arranged for floor mounting.

At present the alternating-current supply is available at Little Holland, where a sub-station, consisting of a substantial brick building, has been erected. In this sub-station there are two 100-kVA transformers, two extra high-tension truck type switch cubicles, for 11,000/11,800 volts, and a low-tension switchboard, with two transformer panels and three feeder panels, equipped with the necessary switches, fuses and instruments. On one of the transformer panels there is an earth-testing apparatus. All the new plant, which has now been in operation for some little time, was installed to meet the requirements of Mr. Broadhurst's specification.

DURING the period of the late war the mining service carried on an intensive investigation into the whereabouts of coal deposits in Java. In the Bantam District, West Java, a good variety of coal was found, also lignite deposits of a useful quality. Exploitation was, however, never begun owing to the lack of roads and transport facilities. The Dutch Government, it is said, is now planning the extension of the system of roadways in Bantam, which extension will include the coal areas discovered on the south coast and near Bodjong Manik in this residency, so that a Government coal mining industry may be established in Bantam in the not very distant future.

The Summer Train Services in France.

THIS year the general note is acceleration, cutting out of intermediate stops, and improved cross-country services. France has no 400-mile non-stop run; the non-provision of water troughs, except on the State Railway renders them impossible, but many new runs of over 100 miles non-stop have been introduced, and in many cases the speed has been greatly increased.

The improvement is specially notable in the international services, such as Amsterdam–Basle, by Strasbourg; Zürich, Lausanne, Geneva, to Marseilles and Nice; England, *vid* Laon to Switzerland, and *vid* Dunkirk to Metz, Strasbourg, and Basle; while on the interior services there are numerous improved and accelerated through services from Paris to the coast and watering resorts.

The State Railway has accelerated its trains to Rouen, 86·9 miles, which is covered in 93 min., a speed of 56·06 m.p.h.; while its longest non-stop run is Paris to Saumur, 177·6 miles, in 3 h. 31 min., which implies fine work, considering the time required out to Versailles. Paris–Le Mans, 131 miles, is run non-stop in 2 h. 33 min., and Le Mans–Rennes, 101 miles, in 1 h. 56 min. These are all new non-stop runs.

The Paris–Orleans Company has no 100 miles non-stop train—its important towns are too close to each other—but there is acceleration, especially to Southern Brittany, where Pullmans are run to La Baule.

The Midi has no 100-mile non-stop run, but has the fastest start to stop run in France—Bordeaux–Dax, 91·9 miles in 89 min.—and it gives on this, an electrified line, an improved and accelerated service.

The P.L.M. has greatly improved and accelerated its service, but its only 100-mile non-stop run is Dijon–Lyons, 122·3 miles, in 3 h. 38 min. The other trains towards Switzerland and Savoy have stops in the working time-table, which are not shown in the public book. There is still a lot of relaying of the track being carried out, which prevents any high booked speeds, but the punctuality is excellent, lost time being made up. Rumour has it that next winter the day "Côte d'Azur rapide" from Paris to Nice in about 14 h., as before the war, will be re-established. There is no question that it is a perfectly feasible booking with the engines now used.

The Nord continues its high level of speeds and non-stop runs—Paris–Brussels, 193·1 miles; Paris–Calais, 185 miles; and numerous others to Erquellines, Aulnoye, Arras, at practically 60 m.p.h.

The Est has now two runs of over 150 miles non-stop—Troyes–Belfort, 171·2 miles in 3 h. 19 min., and Paris–Bar le Duc, 157·7 miles in 2 h. 55 min.—besides others of over 100 miles, as Paris–Chalons s/Marne, Paris–Troyes, Troyes–Belfort, and Langres–Chalons.

On the Alsace-Lorraine Railway the accelerations are general and important. The late ingénieur en chef, materiel and traction, has obtained sanction for the maximum authorised speed now to be 110 kiloms. an hour, and the bookings have profited. The fastest train is Mulhouse–Strasbourg, 67·6 miles in 1 h. 13 min.

The following tables show the longest non-stop runs over 100 miles and the quickest run on each railway at over 50 m.p.h.

Non-stop Runs Over 150 Miles.

Railway.		Distance. Miles.	Time. h. min.
Nord	Paris–Dunkirk	193·7 ..	3 25
,,	Paris–Brussels	193·1 ..	3 30
,,	Paris–Calais	185·6 ..	3 10
Etat	Paris–Saumur	177·6 ..	3 31
Est ..	Troyes–Belfort	171·2 ..	3 19
,, ..	Paris–Bar Le Duc ..	157·7 ..	2 55

Over 100 Miles.

Nord	Paris–Erquelines	149 ..	2 33
,,	Feignies–Paris	147·6 ..	2 30
,,	Paris–Etaples	140·9 ..	2 20
,,	Paris–Aulnoye	134·1 ..	2 15
Etat	Paris–Le Mans	131 ..	2 33
Nord	Paris–Arras	123·5 ..	2 01
P.L.M.	Dijon–Lyons	122·3 ..	2 38
Est ..	Troyes–Port d'Atelier ..	120·4 ..	2 21
,,	Chaumont–Belfort	112·4 ..	2 13
,,	Paris–Chalons	107·4 ..	1 54
,,	Langres–Chalons	104·9 ..	2 00
Nord	Calais–Amiens	104·3 ..	1 51
Est ..	Paris–Troyes	103·7 ..	1 46
Etat	Le Mans–Rennes	101 ..	1 56

Fastest Booked Run on Each Railway Over 50 m.p.h.

Railway.	Section.	Distance. miles.	Time. h. min.	Speed. m.p.h.
1. Midi ..	Bordeaux–Dax ..	91·9 ..	1 29 ..	61·95
2. Nord ..	Paris–Arras ..	123·5 ..	2 01 ..	61·24
3. Est ..	Paris–Troyes ..	103·7 ..	1 46 ..	58·70
4. Etat ..	Paris–Rouen ..	86·9 ..	1 33 ..	56·06
5. P.O. ..	Les Aubrais–Paris (Austerlitz) ..	73·2 ..	1 19 ..	55·59
6. A.L. ..	Mulhouse–Strasbourg	67·6 ..	1 13 ..	55·56

This is a fine list, which shows a marked progress, especially in view of the fact that booked time is improved on frequently. Paris–Troyes has, for instance, been done in 1 h. 35 min. when time had to be made up.

The timings in the foregoing are taken from the official public time-tables.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

THERE is little change in the market situation in the Midlands and Staffordshire on the week. Demand is steady, but remains poor in bulk. Only short date contracts are entered into, inducements offered by some producers having failed to attract forward business. Values are very much as they were a week ago. There has been some firming up of prices of steel semis, and the weakness recently noticed in raw iron has increased. Iron and steel works in this district are not able to make full time and many of the consuming industries are experiencing difficulty in keeping plant running. Fortunately, the rolling stock establishments continue to call for fair quantities of steel and finished iron, and are also absorbing a goodly number of castings, thus finding employment for the foundries. Several local industries requiring metal for stamping and working up purposes have this week placed good orders. The weekly meeting of the Midland iron trade in Birmingham to-day—Thursday—was only moderately attended, and although the market remained optimistic in tone, some concern was felt as to the immediate future.

Pig Iron.

The instability of prices in the pig iron department furnished the chief item of interest in the market. It has been held for some time past that market prices have been unremunerative, and the further fall in values has caused consumers to speculate as to the minimum price which smelters would accept for their production. Despite the fact that extremely few Midland furnaces are active, output exceeds demand, and blast-furnacemen whose stocks have become unwieldy needs must sell them or further curtail production. The latter course they do not wish to take, except as a last resource, and, consequently, some of them have made further sacrifices and disposed of a proportion of their stocks at prices which, it is claimed, have no relation to production costs. Other houses endeavoured to abide by recent quoted rates, but values subsided further. Derbyshire No. 3 foundry was quoted £3 1s. to £3 2s. 6d., or 1s. 6d. per ton lower than last week's nominal figure. Northamptonshire makers asked £2 16s. 6d. to £2 17s. for foundry iron, while North Staffordshire makers refused to accept anything less than £3 2s. 6d. for their production. Forge irons sold slightly better, Northamptonshire making about £2 13s. 6d. and Derbyshire £2 18s. There was no indication of any reanimation of consumptive demand, and from Midland ironmasters' point of view the position is becoming extremely serious. Small quantities of Welsh and Scotch iron continue to find their way into this district.

Finished Iron.

Ironmasters have experienced some falling off in demand for best grade bars, and mills are only with difficulty kept running regularly. There are still fair orders on makers' books, however, and though prospects of orders from the shipyards are not over-bright, it is confidently anticipated that engineering requirements will improve. The £12 level for marked bars is maintained, ironmasters being of opinion that any lowering of values would fail to stimulate buying while consumptive requirements remain as small as they are just now. It is fortunate that the Midland wagon builders are well employed, for they have proved, and are still proving, good purchasers of best class Staffordshire iron. In the Crown bar branch of the market prices continue to be cut and the export trade is the subject of keen competition with Lancashire. Quotations this week were as low as £9 2s. 6d. Staffordshire makers would not accept business below £10. The price asked for nut and bolt and fencing iron is £8 17s. 6d. minimum. The situation here is much brighter, the proportion of native material to foreign being bought continuing to increase. Black Country nut and bolt works are moderately busy, but the chain-making industry has gone quiet again. Wrought iron gas tube strip is selling slightly better at £11 per ton, business having shown some expansion at the local tube works since the holidays. It is not evenly-distributed, however.

Galvanised Sheets.

Demand for galvanised sheets, both on home and foreign account, remains poor and manufacturers fail to discern any indication of the increased export buying which has been anticipated for some weeks past. The state of the mills may be to some extent gauged from the fact that some producers now offer deliveries within three or four weeks. The quotation of £13 5s. for 24-gauge corrugated sheets is upheld, mills being apparently unanimous in their intention not to revert to the low selling prices which ruled during the previous slump in demand. Motor engineering firms are absorbing considerable tonnage of black sheets, values of which are unchanged.

Steel.

Small orders for structural steel are reaching Midland mills, but the volume of trade in this department is most disappointing. Prices are substantially unchanged. Angles and joists cost £7 17s. 6d., tees £8 17s. 6d., ship, bridge and tank plates £8 12s. 6d., boiler plates £11. Steel masters report an increase in the number of consumers taking advantage of the rebate scheme. Local boilermakers are fairly employed, but many structural undertakings are still held up, and the local yards are comparatively speaking quiet for the time of the year. In the semi-finished branch of the market conditions are brighter, British mills are keenly competing with the foreigner for all the available business, and even though in some instances continental sellers have "cut" their recognised prices, native makers have secured good orders in open competition. The diversion of trade to native mills is most apparent in regard to billets, small bars and steel tube strip. Home producers of billets generally quote £6 or more for their products, even Welsh mills being unwilling to accept the old price of £5 15s., which would be below the present German quotation of £5 17s. 6d. Small rolled bars and tube strip are both quoted £7 10s., against £7 5s. asked for foreign material. With values so closely approximating one to the other, it is not surprising that an increased amount of business is being given to local makers who are prepared to give delivery as required. Foreign sheet bars at £5 17s. 6d. fail to offer any attraction to local users who can buy British at £6 2s. 6d. It is a great pity consumptive requirements are not larger just now when native steel works could secure the work. Demand is comparatively small, and orders are to cover immediate requirements only.

Scrap.

The call for heavy steel scrap is maintained and sellers have no difficulty in making £3 7s. 6d. delivered South Wales. Some holders this week quoted £3 10s., but it is believed that consumers have been unwilling to purchase at this figure.

Unemployment.

Unemployment in the Midlands has decreased by no less than 43,948 in one week, and the decline is expected to continue, though in smaller measure. For the week ended June 4th, the Ministry of Labour's returns showed the number of persons out of work to be 164,694, whereas the previous week the figure had been 208,642. There was an appreciable reduction in most of the Black Country towns, Birmingham, Oldbury and Wolverhampton furnishing the exceptions. The total unemployed in Birmingham is now 26,727, as against 25,571 a week ago. Of the total unemployed in the Midlands 127,787 are men, 30,562 women, 3460 boys, and 2885 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Industrial Outlook.

THE *Monthly Record* of the Manchester Chamber of Commerce, in the course of its survey of general industrial conditions, refers to the situation of the engineering trade locally in the following terms:—"The engineering trade has made some progress of late, one indication of this being an increased inquiry for machine tools and particularly for those of special types. Most electrical engineers have had a fair amount of work on hand, and gas and oil engines have been in increased demand. There has also been some activity in gear cutting for motor-car makers and for other engineering shops as well. Textile machinery for the home trade is still in small demand, and is likely to be for some time, with the exception of machinery for the production of artificial silk. Cotton spinning and weaving machinery has had dull markets overseas, this applying alike to the Continent, the Far East, and South America. It was reported, however, last month that Russia is arranging to place large orders here."

Coal Marketing Scheme.

In a reference to the effect of the co-operative coal marketing scheme on stocks, the *Monthly Record* points out that the scheme for Lancashire, Yorkshire and the Midlands has had the effect of reducing stocks and stiffening prices a little for some descriptions. Some of the Hull coal exporters complain that they were unable to get all the supplies they wanted in April, and an increase in the output permitted by the combine has been made. Industrial fuel for home use has only been in moderate demand, and house coal sales have fallen off owing to the weather being more genial during part of the past month.

Locomotive Shops on Short Time.

It is expected that the locomotive shops at Horwich of the London, Midland and Scottish Railway Company, which normally employ about 3000 men, will begin short-time work at the end of the present week, working five days a week until further notice. It *is* understood that about ninety men employed in the running shed at Horwich works have been informed that the department will be closed down next month, the men having been given the choice of three other sheds near Horwich to which they can be transferred.

Order for Paper-making Plant.

It is understood that Charles Walmsley and Co., Ltd., paper-makers' engineers, of Bury, have secured an order from a paper mill company in Finland for paper-making machinery and other equipment, the total value of the order being in the neighbourhood of £100,000.

Diesel Oil Engine Makers' Dividend.

A dividend of 6 per cent. on the ordinary shares, which is at the same rate as a year ago, is announced by the directors of Mirrlees, Bickerton and Day, Ltd., manufacturers of Diesel oil engines, Hazel Grove, Stockport.

Non-ferrous Metals.

In some sections of the non-ferrous metals market of this centre a fairly active business has been reported during the past week. Price movements have been of relatively little moment; tin experienced a further though comparatively unimportant decline, lead a slight reaction after the successive advances that have characterised this section during the previous three weeks, and copper an improvement to the extent of about half-a-crown a ton for cash metal. Spelter was maintained at about the price that has been ruling during the past month. With stocks of copper in this country, and particularly of refined qualities, increasingly scarce and offers of metal by holders

rather reserved, continued firmness may be expected, especially as the demand from consuming centres is being maintained at a fairly satisfactory level. The obvious explanation of the steady decline in tin is the statistical weakness in this section, supplies being more than sufficient to meet the current demand, although the latter is by no means unsatisfactory. Buying interest in spelter during the week has been very pronounced, but in spite of this, values have kept very steady. Lead prices have reacted a little, although there is still a fair movement in this section of the market.

Iron.

To the extent that certain makers of Midland foundry irons have been able to report a rather better tonnage sold on this market than for some little time, the course of events during the past week may be said to have been satisfactory. This experience, however, seems to have been by no means general, and it is evident that conditions are still very patchy. The bulk of the fresh buying has been on comparatively early delivery account, though some of the successful selling firms report the booking of a number of replacement contracts for delivery over the next few months. Generally speaking, the pig iron market is far from strong, although so far only Midland varieties have given way to any appreciable extent. Competition among Staffordshire and Derbyshire makers is extremely keen, and the consequence is a good deal of price uncertainty, with low offers mentioned here and there. About the best figure that is now obtainable for Midland foundry irons is 70s. per ton., for delivery Manchester or equal. North-East Coast makers are holding firmly to 79s. per ton for delivery here, with Scottish brands somewhat easier at 86s. to 87s. 6d., and West Coast hematite at 82s. 6d. to 83s. Manufactured iron is in continued quiet demand, but prices are fully maintained at £10 per ton for Lancashire Crown bars and £9 10s. for second quality material.

Steel.

Local constructional engineering firms are fairly busy on the whole, and are by far the most important buyers on the Lancashire steel market, but, although they are placing orders for a fair aggregate tonnage of steel, they are by no means anxious, unless the circumstances are exceptional, to depart from their policy of purchasing on a strictly early rolling basis. Occasional moderate orders for boiler-plates are being placed by locomotive engineering firms in Lancashire, but in steel bars only a quiet trade is passing. Quotations are steady in all directions, with large bars at £8 17s. 6d. per ton, small re-rolled bars at from £7 15s. up to £8 in some cases, joists and sections at £7 17s. 6d., ship and tank plates at £8 12s. 6d., acid boiler plates at about £10 per ton, and basic varieties at 5s. below this figure. Rather more buying interest has been shown on this market in imported steels and sellers of continental materials report better sales recently, more particularly of wire rods and of semi-finished materials. In the absence of any business of importance recently prices of foreign steels have been nominally firm, but under the test of actual transactions values have given way a little here and there. Continental sheet bars are now at £5 12s. 6d. per ton, billets at £5 10s., Siemens plates at £8 to £8 2s. 6d., Thomas plates at £7 10s., angles at £6 15s., joists at £6 2s. 6d., and wire rods at about £6 15s. per ton, for cash against documents, and including delivery to Lancashire buyers' works.

Manchester Association of Engineers.

A party of members of this Society, accompanied by the President, Mr. William G. Gass, M.I. Mech. E., paid a visit of inspection to the motor vessel "Cheshire," belonging to the Bibby Line, on Wednesday, 6th inst. The vessel was moored at her loading berth in Birkenhead Docks, and the members were conducted over her by Mr. Hall, the engineer superintendent of the line, and his staff. This vessel was built and launched about eighteen months ago by the Fairfield Shipbuilding and Engineering Company, Ltd., Glasgow, and is employed as a passenger and cargo vessel in the Eastern trade. Accommodation for 270 first-class passengers is provided. The registered tonnage is 10,500. The visitors were chiefly interested in the propelling machinery, which consists of two sets of Fairfield-Sulzer two-cycle, single-acting Diesel engines, each engine having eight working cylinders 28in. diameter by 39in. stroke. The two engines are capable of developing together a brake horse-power of 7700 at 710 revolutions per minute. Practically the whole of the auxiliary machinery of the "Cheshire" is driven electrically, but the two three-stage main air compressors for injection air are driven by cranks at the forward end of each engine, scavenging air being supplied by two British Thomson-Houston turbo blowers, each of which is capable of supplying the full quantity of air to both engines. Each of these blowers is electrically driven by a motor capable of developing 460 horse-power. The visitors were much impressed by the spaciousness of the engine-room and the accessibility of the motive mechanism, which, it was explained, has given complete satisfaction on the two round trips which the vessel has already made. The length of the ship is 502ft. overall, and the moulded breadth 60ft. She has five decks, the two uppermost decks being devoted chiefly to the passengers' quarters, which are fitted out with all the most modern appliances. A feature of the cabins, which are mostly two-berth rooms, is that each is afforded natural light and ventilation, this being effected on what is known as the Bibby principle. The main subdivision of the vessel is effected by light transverse bulkheads extending to the upper deck and dividing the ship into nine water-tight compartments. The cellular double bottom extends the full length of the ship between the peak bulkheads, and is used for the storage of oil, fuel and water ballast. The public rooms were much admired, on account of the tasteful decoration, and altogether the visit was greatly enjoyed.

BARROW-IN-FURNESS.

Hematite.

At the present time more iron is being produced than is being sold, and at some of the works stocks are increasing. This is not a comforting sign, but it has to be faced. Makers will not continue to accumulate stocks for very obvious reasons and, unless there is an improvement in the early future, there will have to be restrictions in some shape or other. The unfortunate feature of the present state of the iron and steel trade is that the steel departments are practically idle, and that the iron which would nominally have gone for conversion is going into stock to some extent. There have been times when some of the overmake of iron went across the Atlantic if it was of special quality, but the American trade at present is, to say the least, dull. There is a certain amount of continental business, but the tonnage is not by any means heavy. Home buyers are content to purchase only for immediate requirements, and are not inclined to place orders for forward delivery. There is no disguising the fact that the pig iron trade is very quiet, and there are no signs of an improvement. The ore trade is moderate, both as to local and to foreign sorts. The steel market is dull, and there are not sufficient orders held to encourage mill owners to restart. The only mills working steadily are the hoop mills at Barrow.

Barrow Electricity.

The Barrow Corporation Electricity department has a credit balance of over £13,000 on the year's working, which is considered very satisfactory. This credit balance will enable the Committee to swell its reserves.

SHEFFIELD.

(From our own Correspondent.)

Dullness Continues.

THE state of quietude in nearly all branches of the iron and steel trades continues. The demand for basic steel shows no improvement, and, although the production is on a smaller scale than before Whitsuntide, it is not easy to dispose of even this reduced output. The fact that prices of continental steel are still high should be of assistance to local firms, but it has not had much effect yet. The low level to which prices have been forced is emphasised by the experience of the Park Gate Iron and Steel Company. During the year ended March last its output of pig iron and steel was the largest in its history, but the profits were comparatively small. The production reached 172,000 tons of ingots, 92,000 tons of pig iron, and 103,000 tons of finished steel. Mr. Douglas Vickers, the chairman, at the annual meeting last week, remarked that at present there was no indication of improvement in the steel trade. There appeared to be some hardening on the Continent, and if it went on it could not fail to be beneficial to the company. If through some stiffening of prices abroad they could secure even 10 per cent. more orders, it would be of very substantial benefit. He added that at Park Gate, despite the large output, they could produce another 15 per cent. without any capital expenditure at all.

Bar Iron and Wire Rod Losses.

The bar iron trade is suffering severely from lack of orders, largely due to foreign competition. There is a comparatively poor sale for steel bars, strip and wire. William Cooke and Co., Ltd., of Tinsley, Sheffield, report a loss for the year ended March of £25,931. In the previous year they lost £11,375. The directors report that "the company's bar iron and wire rod trades are suffering from lack of orders and unremunerative prices, mainly caused by the greatly increased importation of continental materials. This competition we consider unfair, and brought about by the policy of our Government. Throughout the year prices have been reduced in an endeavour to meet this competition, and to procure even a small quantity of business, but it has not been possible to prevent a heavy loss. The dumping of foreign iron and steel is a serious menace to a very large and important industry in this country, which ought to be employing many thousands of men who are now idle, and would much rather be working."

Railway Material.

The departments making axles, tires and springs for the railways are only moderately employed, but prospects have been somewhat improved by the recent placing of contracts, on both home and foreign account, with Sheffield firms and their associated companies. The specifications of the home companies are, however, on a very economical scale, owing to disappointing returns of goods and mineral traffic. India is sending forward a few inquiries, but the quantities of goods required are disappointingly small. Some useful orders for rolling stock, in which local firms and firms associated with them are to participate, have been placed during the past week by the London and North-Eastern Railway Company. The contracts embrace eighty-two new carriages for use on the London suburban services and in East Anglia. Craven's Railway Carriage and Wagon Company, Ltd., Sheffield, are to build two trains, each consisting of two quadruple sets (sixteen carriages); Clayton Wagons, Ltd., Lincoln, two trains, each consisting of two quintuple sets (twenty carriages); the Midland Carriage and Wagon Company, Ltd., Birmingham, sixteen carriages; and the Metropolitan Carriage, Wagon and Finance Company, thirty vestibuled bogie carriages.

Various Branches.

Those branches of the steel trade which cater for special requirements are still among the busiest. A large amount of work is being done for the electrical engineering industry, and the automobile builders continue to be good customers for special steel and various parts. The newer types of alloy steel are experiencing a satisfactorily increasing demand. Several leading firms are enjoying a good call for stainless steel for engineering and chemical purposes. There is a good deal of patchiness about the tool trade, some firms reporting good business, while others are very slackly employed. Generally speaking, there is shortage of work in the saw, file, rasp and edge tool departments. Plate and cutlery are quiet, although some firms have had a little spurt owing to seasonal demands at the holiday resorts. The houses best employed are those engaged on contracts for the table furnishing of ships, restaurants, and hotels.

Electrical Developments.

Large extensions of electrical plant are in progress or in contemplation at several places in this district. Sheffield City Council has adopted a recommendation of the Finance Committee, for the expenditure of no less than £517,926 on additions to the plant and buildings at Blackburn Meadows power station. At the York municipal electricity works there has just been started a new Oerlikon turbo-generator, with a capacity of 6000 kW, installed at a cost of £19,000. The Foss Island station and offices have also been extended at a cost of £6000. The York undertaking was very successful last year, making a profit of about £30,000. Its maximum charge for current is 3½d. per unit. At Leeds, where the Kirkstall power station is being greatly extended, the Electricity Committee recommends acceptance of the tender of H. Arnold and Sons, Ltd., for the work required in the construction of concrete rafts, intake tanks and ducts for £42,103 18s. 6d., and that of International Combustion, Ltd., for the supply of automatic control apparatus for the boiler-house equipment for £7000. At Derby Town Council meeting last week Alderman W. G. Wilkins announced that the town was expected to share very largely in contracts for electrical plant, involving an expenditure of several million pounds, to be placed in the country in the near future. He considered that this justified the Electricity Committee in authorising the engineer to visit various continental power stations to inspect powdered fuel plants.

Lincolnshire Coal.

The prospect of Lincolnshire becoming a large centre of colliery enterprise grows more and more definite. The latest evidence of this is the report that the Weardale Steel, Coal and Coke Company is proposing to work a large area near Gainsborough. The coal is under the Temple Bellwood estate, of 3100 acres, the trustees of which, who intend to lease the seam to the Weardale Company, successfully applied to the Railway and Canal Commission last week for the grant of certain ancillary rights in regard to the support of the surface, wayleaves, and the erection of coke ovens and by-product plant. It was explained that the coal under the estate formed part of a much larger coalfield of the Barnsley seam, which the company intended to work. It was expected to be found at a depth of 3000ft., and the intention was to work it on the longwall principle. It was hoped to obtain 40,000,000 tons from this area. It was believed that there was a very large quantity of coal in this part of Lincolnshire.

Dry Cleaning of Coal.

Thorne Colliery is about to bring into use the new dry cleaning washer, which has been erected to supersede the ordinary water washer. The coal is cleaned by currents of air, and coal dust is sucked through a suction pump and consumed in boilers laid down specially for the purpose. An official explained that the main idea of the plant is to screen smalls. One of the many distinctions between the apparatus and an ordinary water washer is that the dirt is pneumatically separated from the coal. The material is sorted into four different sizes, and the machine is capable of dealing with 130 tons per hour.

New Industry for Burton.

The industry of motor tire making is to be established at Burton-on-Trent by Pirelli, Ltd. This announcement was made at a meeting of the Burton Town Council by Councillor W. H. Giles, acting chairman of the Commercial Development Committee, who said that the plans were practically completed. Officials of the company had visited the site, and had their plans so advanced that an immediate start would be made when all details were settled and possession of the land given to them. There was a small hitch with the railway company, which he had every expectation would be satisfactorily dealt with in a day or two. The land, which comprises 46 acres off the Derby-road, belongs to the Corporation, and it is not anticipated that there will be any difficulty in obtaining the Ministry of Agriculture's consent to its sale. Mr. Giles said it was hoped that ultimately at least 1000 people would be employed, of whom 60 per cent. would be men and boys, and probably only fifteen to twenty "key" men would have to be brought into the town. He added that Messrs. Pirelli had seven factories in Italy, three in Spain, and one in South America, employing a total of 15,000 persons, while the cable factory erected at Southampton sixteen years ago now had about 1800 employees

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

INQUIRIES circulating in the Cleveland iron trade are on a disappointing scale, and actual transactions fall much below expectation. Factors that should stimulate trade are having little or no effect on the unsatisfactory situation, and an outstanding discouraging feature is the increasing uneasiness concerning economic conditions. Stocks of Cleveland pig iron are extremely low, but still the tendency is, if anything, further to limit production. Two more furnaces, for instance, have been put out of commission, one at the Consett Ironworks, and the other at the Carlton Ironworks, thus reducing the number in blast in the district to thirty-five—which is five fewer than at the beginning of the year. Consumers in Scotland have still large quantities of Cleveland iron to accept in fulfilment of fairly heavy business put through some time ago, but they are not keen to take up iron as it becomes due, and they are purchasing parcels of Midland iron on much lower terms than rule for Cleveland qualities. Export demand keeps very light, but is expected to show some

little improvement in the near future. Prices are unchanged, No. 1 Cleveland foundry being 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

A few more sales of East Coast hematite pig iron to home users and to continental buyers are reported, but the volume of trade passing is a good deal short of absorbing the restricted output, and the already heavy stocks are being steadily increased. In such circumstances prices, which for some time past have been altogether unremunerative, are not upheld. Quotations are not definitely fixed, and while nominally recognised market rates are based on 69s. for mixed numbers, buyers experience no difficulty in placing orders on lower terms.

Ironmaking Materials.

The demand for foreign ore shows no signs of expansion, but with probability of scarcity of supply later in the year sellers are not disposed to depart from their firm attitude. Best Rubio ore keeps at 22s. 6d. c.i.f. Tees. Durham blast-furnace coke is not taken up at all freely for local use, but considerable export business has been put through, and sellers are not pressing supplies on the market so insistently as they have been. Good average qualities remain at 17s. 6d. to 17s. 9d. delivered to consumers' works in this district.

Manufactured Iron and Steel.

There is no special feature in the manufactured iron and steel trade. Distribution of specifications for shipbuilding requisites are on a very unsatisfactory scale, and there is much room for improvement in the demand for railway material; while the orders for constructional material are far from what could be desired. Big work is understood to be pending, but fear is entertained that it will take some time to mature, and meanwhile manufacturers are running short of orders. Producers of semi-finished steel are stated to be doing rather more business as the result of continental manufacturers now requiring a lengthy period for delivery.

The Coal Trade.

The placing of a fair portion of the Swedish State Railways' order in this district is welcome, but it is scarcely likely to give any uplift to the steam coal market generally. The business for Northumberland coals was taken on a speculative basis, for after deducting a potential freight figure the f.o.b. price remaining for the coals is some coppers below what is being currently quoted by sellers. Tyneside coal-exporting firms will ship over 40,000 tons, and the 32,000 tons of Broomhill coals will be shipped direct. So far June has been a disappointing month for the Northern coal trade. Sellers were hopeful at the beginning of the month that a brisker trade was impending, but expectations have not materialised. The general outlook has again clouded over, and the collieries are faced with the alternative of further curtailing the output or reducing prices to a more competitive level with other producing counties in this country and foreign suppliers. The position for this month is regarded as likely to hold steadily, but for the second half of the year the outlook is very unsettled, as many high-priced contracts are finished at the end of the month, and there is not much business being done forward to counterbalance the position. Thus, whilst merchants are generally regarded as having stood the brunt of the weakness in trade over the past few months, the forward period is likely to give the coalowners a more severe testing, and without the help of the merchants they have to face growing competition from Scotland and Yorkshire. The Northumberland steam coal section is steady for prompt, but nominal after this month. Best steams are quoted at 13s. 3d. to 13s. 6d., and secondary kinds at 12s. Durham large steams seem to have a steady trade booked. Gas coals of every description are plentiful and easy, but unchanged in value, and coking coal and ordinary bunkers show much the same features. Coke is tending to be increasingly active. The prompt trade in gas coke could be larger, but there is a sustained demand for forward positions. Patent foundry coke is firmly placed both for prompt and forward. Gas coke, prompt, 19s. 6d. to 20s. 3d.; forward, 20s. to 21s.; patent oven cokes, 18s. to 18s. 6d.; prompt, 18s. to 19s. forward.

SCOTLAND.

(From our own Correspondent.)

Dull Prospects.

BUSINESS in the steel, iron and coal trades shows little, if any, change, and markets are practically devoid of any feature calculated to inspire confidence in the immediate future.

Steel.

The general demand for steel is unsatisfactory, especially for heavy material and ship plates in particular. Small steel bars, hoops and sections have a fairly steady turnover, but there is an absence of anything approaching what might be termed a substantial order. Heavy steel scrap is quoted 65s. per ton, with heavy basic about 5s. per ton less.

Steel Sheets.

The demand for black and galvanised sheets cannot be termed satisfactory, and orders for all descriptions would be welcomed. Black sheets, ¼in., are unchanged at £8 12s. 6d. home, £8 10s. export, and galvanised corrugated sheets, 24 g., at £13 5s. home and £13 per ton export are also without alteration.

Iron.

The demand for bar iron continues slow and there is keen competition for export orders in iron as well as in re-rolled steel bars and sections. Bar iron prices are unchanged, while the prices of re-rolled steel are about £7 10s. per ton home and £7 per ton export.

Pig Iron.

The pig iron market continues firm, though inactive, prices showing no change.

Exports and Imports.

Arrivals at Glasgow Harbour during the past week included 5800 tons iron ore and 2400 tons of steel and iron. Shipments of steel and iron products amounted to about 7000 tons, which were sent chiefly to the Colonies, Japan, China and Spain. Pig iron shipments amounted to 332 tons. Fair consignments of machinery and structural material were also sent abroad.

Locomotive Orders.

Following on recent good orders for locomotives another contract has just been reported in the nature of an order for fifty side-tank locomotives for the Great Western Railway, which has been secured by the North British Locomotive Company, Ltd., Glasgow. This same firm has orders on hand for the Argentine, South Africa, and the London and North-Eastern Railway, and full-time employment is being extended throughout all departments.

Coal.

The efforts of the collieries to equalise supply and demand by a curtailment of outputs have not met with the desired success, and a further effort is being made. It is doubtful if much progress can be made at this season of the year, owing to the diminished demands for home consumption on the part of utility concerns and householders alike. Meanwhile shipping business shows no signs of expansion, and though quantities offered are considerably reduced, prices are hardly steady. Exporters, too, are not supplying shipping tonnage to the required amount, and otherwise show an inclination to proceed with caution. Best splints are well sold, but have been quoted on occasion at a slightly lower price than recent levels. Best Fifeshire steams have a fairly steady turnover, but second-hand offerings at less than colliery prices keep the market for these somewhat easy. Lothians steams move steadily. Washed nuts on the whole are irregular, but a shade better than during the past week or two. Aggregate shipments amounted to 200,682 tons, against 236,660 tons in the preceding week and 237,044 tons in the same week last year.

Miners' Wages.

Scottish miners' wages during the month of June will be unchanged. Realised prices for April and March show a trading deficit of over £227,145, which will be carried forward. The total deficit is now £3,390,678. Average earnings during March per person were 9s. 3¼d. and 9s. 2d. for April.

New Lanarkshire Colliery.

The first sod of a new colliery in Lanarkshire has just been cut. The Kingshill coalfield, Lanarkshire, is about 5 miles long and 3 miles broad, and at present the western area is worked by Kingshill Colliery No. 1. The new colliery—Kingshill No. 2—is situated 925ft. above sea level, and the power used will be entirely electrical. Winding, screening and washing plant to deal with an output of 1000 tons per eight hours' shift is being installed. When Nos. 1 and 2 collieries are working together, it is estimated that the yearly output should be about 1,000,000 tons.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

RETURNS of foreign coal shipments from South Wales for the month of May have turned out better than expected. The total shipments as cargo came to 1,823,983 tons, which compares with 1,655,227 tons for April. At the same time the comparison is not so favourable when the figures for May are set against those for the same month of last year, when the total came to 2,259,431 tons, there being a reduction of 435,448 tons. It will be seen that there is a great deal of ground to be made up. Unfortunately, the immediate prospects do not appear to be any too bright, for the returns of shipments so far this month have been very disappointing. For the week ending the 8th inst., the total came to only 282,040 tons, which compares with 342,743 tons for the preceding week. Such a substantial falling off is almost inexplicable, but it may be that the method of compiling the weekly export figures has something to do with the extreme fluctuations which take place in the returns. It is true that the tonnage position has not been quite as satisfactory as could be desired, but it has certainly been worse. The week ended with a total of twenty-six idle tipping appliances at the South Wales docks, and this week opened with twenty-five vacant berths, and five vessels waiting to berth. This being the case, it is impossible to look for a material expansion in shipments, and, furthermore, not only is fresh business very quiet, but chartering operations cannot be described as having been active lately. Some slackening off in the coal trade is, of course, expected at this time of the year, and coming on top of the depressed conditions which have prevailed for so long, it will, of course, prove very serious for all concerned. Still, the future is not without hope. Foreign competition, which has been so keen, is waning slightly. Hopes had been entertained that long ere this some beneficial effect would have been felt on this side as the result of the strike troubles which have been experienced for the past month or so on the Rhine, and which have held up German exports; but the fact that little fresh business has come to this district only points to the conclusion that stocks of coal in all continental countries are in excess of requirements.

Gas Engineers and Coal.

The members of the Institution of Gas Engineers are holding their annual gathering this week at Cardiff for the first time. At a dinner given on Monday night, it was announced that the Institution had applied for a Royal Charter. Sir Arthur Duckham, in proposing the toast of "The City of Cardiff," said that they were particularly concerned with coal and coke, and he felt he could say that an advance was coming in the coal situation. It was bound to improve, because the demand was greater than the supply. Competition from Germany, too, was growing less, and the cost of production in that country was going up. The same was true of France, and the only places they had to fear were Belgium and Luxembourg. American competition had already lessened. There had, too, been a good deal of competition from within, and he did not feel it was altogether good for the industry. Steps were being taken to find a remedy and they in the gas world would be pleased when the coal industry in South Wales and elsewhere was in a happier position.

South Wales Miners.

At a meeting of the Executive Committee of the South Wales Miners' Federation held at Cardiff at the end of last week to consider resolutions to go on the agenda of the annual Conference of the Miners' Federation to be held in July, it was resolved that the Miners' Federation should be called upon to take immediate steps to secure the return to a national agreement for the regulation of wages and also calling upon the Government for an amended Minimum Wage Act. Another resolution condemned the coal owners for increasing the hours of labour and reducing wages, and urged the nationalisation of the mines as the only remedy for the present deplorable condition of things in the industry.

Ebbw Vale Developments.

The No. 4 mill at the Upper Works belonging to the Ebbw Vale Company was restarted after a considerable period of idleness on Sunday. It will mean the re-employment of 250 men. Three shifts will be worked at the mill for the first time. Practically the whole of the various branches of this large undertaking are now in full employment.

Steel Works Fire.

As the result of a disastrous fire which broke out at the power station at the Ifor steel works, Dowlais, on Monday afternoon, over 3000 steel workers and colliers are rendered idle for an indefinite period. The power station is one of the most modern in this district, and contains two steam turbo-alternators, the power being supplied to the Dowlais Company's iron and steel works and collieries.

Commercial Development.

It is reported that an important scheme is afoot for the extraction of oil from coal in South Wales. A company, to be known as British Benzol and Coal Distillation, Ltd., is being formed with a capital of £250,000, the chairman being Sir Neill Malcolm, other directors being Sir Arthur Duckham, Sir Samuel Instone, Mr. G. R. Hall Caine, and Colonel H. C. Woodcock. Plant is to be erected at Bedwas, and is expected to be in full operation next year. It will have a capacity for manufacturing during the course of a year 1,400,000 gallons of motor spirit and other oils, as well as large quantities of coke.

Current Business.

There has been no perceptible improvement in the general demand for steam coals, and the market continues to be very quiet. At the same time the position of those concerns producing the superior grades is fairly satisfactory. They are working regularly, and in several instances they are able to command prices 3d. in advance of the minimum figures ruling. The weakness of the market is chiefly in respect of dry coals and inferior descriptions, for which there is only a very moderate demand. Small coals maintain a steady tone. It is reported that the Executive Committee of the Marketing Association has fixed the minima for smalls and duff for inland sales at 1s. 6d. per ton below the f.o.b. minimum prices, which for smalls range from 10s. to 12s. 6d. per ton f.o.b. The patent fuel and coke sections display no new feature.

LAUNCHES AND TRIAL TRIPS.

JENNY, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of A/S. Oljefart; dimensions, length, 344ft.; breadth, 53ft. 5½in.; depth, 28ft. Engines, single-acting, two-cycle Diesel, 600 mm. bore by 1200 mm. stroke; trial trip, May 22nd.

YAMANOTA, shallow-draught oil tanker; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co., Ltd., for Lago Shipping Company; dimensions, length, 315ft.; breadth, 50ft.; to carry 2360 gross tonnage. Engines, twin-screw triple-expansion, pressure 180 lb. per square inch; launch, May 22nd.

PACIFIC EXPORTER, twin-screw motor cargo and passenger vessel; built by Blythswood Shipbuilding Company, Ltd.; to the order of Gulf Line, Ltd.; dimensions, length, 450ft.; breadth, 60ft.; depth, 42ft. Engines, twin sets of single-acting Diesel engines; constructed by J. G. Kincaid, Ltd.; trial trip, May 23rd.

SCOTTISH HEATHER, single-screw steam oil tanker; built by Sir W. G. Armstrong, Whitworth and Co., Ltd.; to the order of Tankers, Ltd.; dimensions, length 455ft., breadth 56ft. 8in.; to carry, 10,000 tons. Engines, inverted direct-acting surface-condensing quadruple-expansion, pressure 250 lb. per square inch; trial trip, May 25th.

BRITISH FREEDOM, oil tank motor vessel; built by Palmer's Shipbuilding and Engineering Company, Ltd.; to the order of British Tanker Company, Ltd.; to carry 10,000 tons deadweight. Trial trip, June 5th.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/- to 21/-
(1) Spanish	19/- to 21/-
(1) N. African	19/- to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 10 0 to 3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 9 0	3 9 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 16 6 to 2 17 0	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 1 0 to 3 2 6	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 2 0	—
No. 4 Forge	3 0 0	—
Basic	3 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 0 (a); 4 4 0 (b); 4 7 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	11 10 0 to 12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 17 6 to 9 0 0	—
Gas Tube Strip	11 0 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 10 0
Sheets (Gal. Cor. 24 B.G.)	13 5 0	13 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
MANCHESTER—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 15 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6	—
,, (Lancs. Boiler)	10 0 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 to 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0 to 6 7 6	—
Hoops	9 10 0 to 10 0 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars	7 10 0 to 8 0 0	—
Billets and Sheet Bars	5 17 6 to 6 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 5 0 to 13 7 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/6 to 18/7½
Block Tin (cash)	222 5 0
,, (three months)	220 10 0
Copper (cash)	64 3 9
,, (three months)	64 3 9
Spanish Lead (cash)	21 5 0
,, (three months)	21 11 3
Spelter (cash)	25 17 6
,, (three months)	25 12 6
MANCHESTER—	
Copper, Best Selected Ingots	68 10 0
,, Electrolytic	69 5 0
,, Strong Sheets	94 0 0
,, Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0
,, Condenser, lb.	0 1 2
Lead, English	22 15 0
,, Foreign	21 10 0
Spelter	26 0 0
Aluminium (per ton)	£107

FERRO ALLOYS.

Tungsten Metal Powder	1/7½ per lb.	
Ferro Tungsten	1/3¼ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 2 6	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£21 15 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£34 0 0	12/-
,, ,, ,, 1 p.c. carbon	£40 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£45 0 0	17/-
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (per ton)	£13 10 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	4/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	16/3 to 17/-
,, ,, Trebles	13/3
,, ,, Doubles	12/3
,, ,, Singles	11/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	12/6 to 12/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 12/9
Screened Navigation	18/-
Trebles	12/3 to 12/6
Doubles	12/6
Singles	11/3 to 11/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/-
Secondary Steam	11/6
Trebles	12/3
Doubles	12/-
Singles	11/3

ENGLAND.

(8) N.W. COAST—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
NORTHUMBERLAND—	
Best Steams	13/3 to 13/6
Second Steams	11/9 to 12/-
Steam Smalls	9/- to 9/6
Unscreened	11/9 to 12/-
Household	21/- to 27/-
DURHAM—	
Best Gas	15/-
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	17/6 to 18/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/- to 20/6 —
Screened House Coal	16/- to 17/6 —
,, ,, Nuts	15/6 to 16/- —
Yorkshire Hards	15/- to 16/- —
Derbyshire Hards	15/- to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export). f.o.b.	18/6 to 19/-

(9) SOUTH WALES.

CARDIFF	
Steam Coals :	
Best Smokeless Large	19/3 to 20/-
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/- to 18/9
Ordinary Dry Large	17/3 to 18/-
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/3
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	11/- to 12/6
Washed Nuts	17/- to 21/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/- to 15/-
,, ,, Smalls	11/- to 12/-
Foundry Coke (export)	30/- to 37/6
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	21/- to 22/-
Pitwood (ex ship)	26/6 to 26/9
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	32/- to 35/-
Seconds	24/6 to 27/6
Red Vein	20/6 to 27/-
Machine-made Cobbles	40/- to 42/6
Nuts	37/6 to 42/6
Beans	23/6 to 26/9
Peas	17/9 to 19/-
Breaker Duff	8/- to 8/6
Rubbly Culm	10/9 to 11/-
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Stabilisation.

THERE is promise of activity in the engineering trades as soon as industry is relieved of the uncertainties that arise from the financial stringency which, it is argued, can only be relieved by a stabilisation of the franc. It is obvious that the Government is prepared to effect the stabilisation as soon as possible, largely under stress of public opinion, but in view of the difficulties of the situation it is by no means certain that the fixing of a legal ratio between the franc and sterling will produce the expected results. It is hoped that a stabilisation will check the steadily increasing prices of all kinds of manufactures and commodities, but if the operation can only be carried out by a liquidation of financial difficulties which may impose further charges on the country, the chances of manufacturers effecting economies and bringing down prices appear remote.

Rail and Road Traction.

The railway companies are adopting a policy of acquiring control over road motor car services with a view of organising them in conjunction with the railways for the transport of passengers, but the problem of collecting light goods and carrying and delivering them more quickly than is at present done with motor cars, at least over long distances, has to be dealt with in an entirely different manner, the idea being to insure express services without breaking bulk when changing from the road to the rail. The use of detachable bodies which can be loaded from the road wagon on to the rail truck does not satisfy railway engineers, who are endeavouring to find a solution of the difficulty by devising a type of vehicle which will run both on the road and on the rail, so that light loads of valuable goods can be conveyed from any point of the territory to another at comparatively high speeds. Experiments were carried out some time ago on a small scale with rubber-tired wheel vehicles, and the results were regarded as encouraging. On that occasion a light vehicle with a body offering the minimum of air resistance was used, and it was fitted with an aviation engine. As a means of showing what can be done, the experiment was interesting. The idea is to keep the vehicles on the rails by means of rollers on a third rail, and on the road a single guiding rail would be laid down either at the side or between two narrow tarred or concrete wheel tracks. On the road the rail guide will only be used in the case of a train of vehicles, while single cars would be steered by the ordinary means. The advantages claimed for the system, apart from the saving of time in passing the vehicle from the road to the rail, are the possibility of running light goods motors at a speed of 50 miles an hour and of permitting the laying down of road tracks at low cost. It is also assumed that if the system can be developed practically it will be possible to organise transport away from the railways, and in the colonies under very economical conditions, as the track will cost little and the use of rubber tires will reduce wear and tear to a minimum.

Sea Temperature Energy.

About eighteen months ago M. Georges Claude presented to the Académie des Sciences a proposal elaborated in conjunction with the scientist, M. Boucherot, for producing energy from the difference of temperature of water taken at the surface of tropical seas and of that raised from a considerable depth. The obvious cost of pumping the water, presumably at a great distance from the power plant, suggested that there would be no advantage in a scheme which, on the face of it, appeared expensive and inefficient, but M. Claude has continued his experiments and M. Boucherot has proclaimed his faith in the value of a method which, apart from any question of energy production, is capable, he declares, of supplying considerable quantities of condensed water in tropical regions for the irrigation of arid wastes. He affirms his belief that, in time, such countries will be made habitable and fertile. Meanwhile, a demonstration power plant has been laid down at Ougrée-Marihaye, in Belgium, and it was inspected lately by several members of the Académie des Sciences. The plant works with the difference between the temperatures of the waste hot water from the steel works and the cold water taken from the bottom of the river Meuse. The plant uses hourly 750 cublic metres of cold water and a similar quantity of warm water, the difference of temperature being from 15 deg. to 20 deg. Cent. The water is pumped into condensers, and the warm water is partially vaporised by the vacuum and loses 3 deg. by cooling during its passage through the turbine, and is immediately exhausted. The cold water condenses the steam and rises in temperature 3 deg. when it is also exhausted. The turbine rotor has a diameter of 1 m. Running with a difference of pressure of 15 to 20 centimetres of water at 5700 revolutions per minute, it drives a dynamo which delivers from 55 to 60 kW. The energy required for the pump and for extracting the dissolved gases mixed with the steam is 18 to 20 kW, so that two-thirds of the energy is available for use. It now remains to be seen what will be the cost of raising water from the bottom of the sea at a considerable distance from the power plant.

Shipbuilding.

The long period of slackness in the shipbuilding industry has not been without producing some good result in showing builders the necessity of specialising, and it is noteworthy that the navy has given a good lead in this direction by a unification of types under the existing programme whereby vessels are turned out much more quickly and cheaply than has hitherto been possible. There is obviously little to be gained by specialising unless orders are forthcoming for the particular types of vessels which builders lay themselves out to construct, and it has therefore been decided to investigate a proposal which has been made to create a new technical and commercial organisation in the form of a bureau of naval architecture which will prepare plans for customers, take orders and pass them on to shipbuilders and machinery makers.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

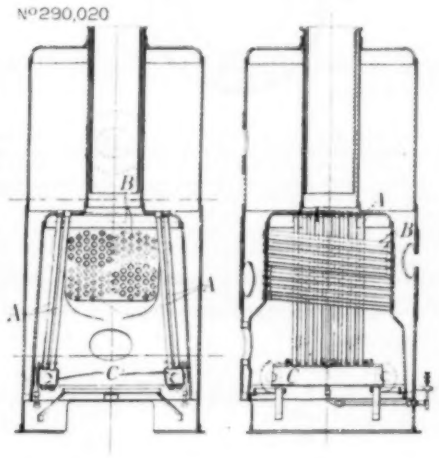
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

290,020. April 13th, 1927.—IMPROVEMENTS IN VERTICAL STEAM BOILERS,—Spencer-Hopwood, Ltd., and Arthur Lincolne Hitchcock-Spencer, both of Hitchin, Herts.

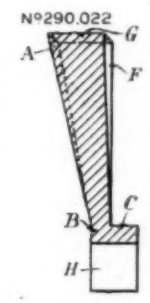
The tubes A which form the feature of this invention are situated on opposite sides of the nests of cross tubes B and within the spaces between the longitudinal sides of the tubes B and the fire-box shell. At their upper ends, the tubes A are supported by the fire-box crown and their lower ends by the mud



drums C. The interior of the headers communicate with the water space surrounding the fire-box. Any suitable means, such as shields, may be provided for preventing the fire making direct contact with the headers. The specification also states that the boiler may be provided with means for directing streams of air above the fire, so as to impart a whirling motion to the products of combustion within the lower zone of the fire-box with the object of facilitating the completing of the combustion at a comparatively early stage.—*May 10th*, 1928.

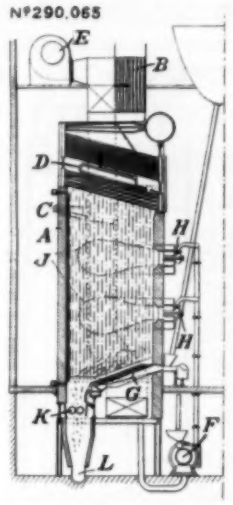
290,022. April 13th, 1927.—IMPROVEMENTS IN TRAVELLING CHAIN GRATES FOR STEAM GENERATOR FURNACES, John Thompson (Wolverhampton), Ltd., and William Harold Gamble, both of Ettingshall, Wolverhampton.

Each link used in the chain grate constructed in accordance with this invention is made of such a cross section that the upper part A is displaced laterally in respect of the lower part B, and at a convenient position along one side of the link a ledge C is formed by which fine dust falling from the fuel on the grate can be arrested. The ledge extends horizontally, but it may be inclined to form a trough. In any case, it allows a certain amount of dust or fine particles to accumulate on it without interfering with the clear air space between the adjacent links. A number of such links are arranged side by side, and a portion of each link overlaps the ledge on the adjacent link. Preferably each side of the links is corrugated by projections F. Also the upper edges are corrugated by projections G. The adjacent edges of the links form a zigzag or corrugated air space. The projections G serve to allow air flowing up the spaces to be spread underneath the fuel supported on the chain. The gap H shown in the underside of the link is for engagement by the driving means on one of the usual end drums. During the travel through the boiler furnace of the upper side of the chain grate on which the fuel rests, a small amount of fine dust or fuel may drop down between the links and be caught by the ledges. After passing through the furnace and over the usual end drum, the links become inverted, and while travelling along the lower path towards the front of the furnace, the dust previously accumulated on the ledges is free to drop away.—*May 10th*, 1928.



290,065. July 9th, 1927.—IMPROVEMENTS IN AND RELATING TO STEAM GENERATOR FURNACES, Riley Stoker Company, Ltd., and Charles Erith, both of Palace Chambers, Bridge-street, London, S.W. 1.

A rectangular straight-walled furnace A is provided, the roof boundary of which is formed by the water tubes of the boiler with an air preheater B which is arranged in the outlet for waste gases. The boiler tubes may be extended in the form of furnace wall screens C, the tubes of which are equally exposed for absorption of radiant heat. A superheater D is provided between the banks of tubes, but this may be replaced or supplemented by a radiant heat superheater comprising fluid-cooled wall screens and taking the place of all or part of the water wall screens C. Air for combustion is supplied under pressure by the fan E and may be preheated by means of the waste gas preheater B. An economiser may be provided if desired. Air ducts are connected to the main duct and lead air under pressure to pulverised fuel burners. Ducts from the branch ducts supply air to pulverisers F. Fuel is supplied from the central bunker to pulverisers F and to the stoker G. From the pulverisers the fuel is supplied to the furnace H of the burners. By the arrangement of the branch ducts the pulverisers receive a supply of primary air, which, being preheated, will dry the fuel during pulverisation. The mixture of primary air and pulverised fuel is delivered to the chamber H of each burner and is caused to be swirled in one direction—for example, clockwise. At the same time secondary air from the ducts is supplied to the burners and is adapted to be swirled in a contrary direction—say, counter-clockwise—whereby a highly turbulent mixture of pulverised fuel and air is projected into the furnace and becomes ignited and is swirled horizontally as a bulbous mass of incandescent fuel in suspension as indicated by the broken line J. The stoker G is a multiple retort underfeed stoker and preferably having reciprocating grates adapted to distribute air between the fuel retorts and to advance the fuel back to the rear end of the furnace. Below the rear end of the fuel bed clinker there are grinding rolls K adapted continuously to discharge to the ash sluice L incombustible ash or residue in the form of clinker from the underside of the thick fuel bed. Water sprays may be provided to quench the clinker as it descends to the grinders. The very fine ash from the pulverised fuel burnt in suspension will fall into the

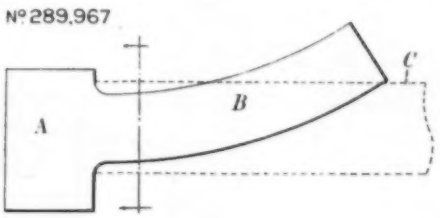


incandescent bed of fuel forming the lower boundary of the furnace and supported upon the stoker G, and thus becomes absorbed and delivered together with ash and clinker from the mechanical stoker as saleable ash or clinker. Untreated fuel is led by conduits to the hopper of the stoker G and is fed by rams through ports in the front wall of the furnace, and as it rises from the retorts and is ignited with air from the grates or tuyeres combustion is substantially completed with very short flames, leaving the upper crust of the thick fuel bed which is fully incandescent. Thus maximum transfer of radiant heat to the boiler is attained and the use of refractory arches is avoided. Any other suitable number of burners may be provided.—*May 10th*, 1928.

TURBINE MACHINERY.

289,967. February 7th, 1927.—IMPROVEMENTS IN AND RELATING TO THE MANUFACTURE OF METAL STRIP SUITABLE FOR TURBINE BLADES, the Hon. Sir Charles Algernon Parsons, and Edward Garrett Brownlow, both of Heaton Works, Newcastle-on-Tyne.

This invention relates to the manufacture of metal strip by an extension process, such as rolling, and is especially applicable to the rolling of metal strip for turbine blades. If, as is usual, the blade-forming portion of the billet is formed for convenience of rectangular or other simple section, it is found that the blade curves to one side during the rolling process, owing to the greater extension of that part of the billet which forms the thinner edge. When strip is rolled in long lengths, no particular difficulty is found in providing guides to keep it straight, but in short lengths, and particularly where each blade is integral with its root, such guiding is practically out of the question. The main object of

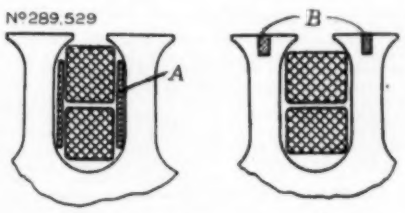


the invention is to overcome such difficulties. The blank or billet has a rectangular root-forming base A of uniform thickness and a blade-forming tail B of rectangular cross section projecting from a side of the base and of the same thickness. The blade-forming portion B of the blank, instead of coinciding in direction with the finished blade, is curved as a whole—as shown by the full lines—to that side on which the thinner edge C of the finished blade will be formed. Such a curved blank may then be gap-rolled in the usual manner, the plane of curvature of the blade-forming portion of the blank lying in what is substantially the common tangent plane of the two gap rolls at about their point of operation. If the initial curvature of the blank is properly chosen, the extra extension of that side of the blade-forming portion which corresponds to the thinner edge C of the finished blade will cause the blank to become less curved during each rolling operation, and finally to become straight, as shown by the dotted lines.—*May 7th*, 1928.

DYNAMOS AND MOTORS.

289,529. January 27th, 1927.—IMPROVEMENTS IN OR RELATING TO REPULSION MOTORS, Christian Jörgensen, of 15, Lindeallé, Odense, Denmark.

The object of this invention is to prevent the tendency of



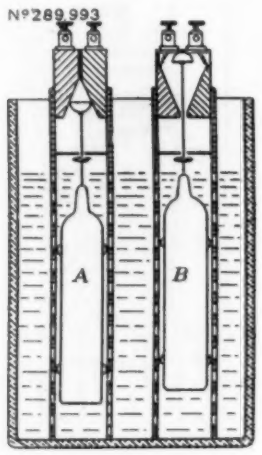
repulsion motors to race. Besides the ordinary winding the motor is provided with copper bars as shown at A arranged at the sides of the ordinary winding. In the right-hand drawing, however

the bars are placed in slots as shown at B. The bars are connected together at the ends of the armature by means of conducting rings.—*April 21st*, 1928.

BATTERIES AND ACCUMULATORS.

289,993. March 2nd, 1927.—IMPROVEMENTS IN DEVICES FOR INDICATING THE CHARGING CONDITION OF ELECTRICAL STORAGE BATTERIES, *George Holme O'Brien, of Lloyd's Bank Buildings, King-street, Manchester.*

The state of charge or discharge of an accumulator is indicated in accordance with this invention by two floats A and B of different density, which close electrical circuits and thereby give a visual or other indication of the condition of the battery,

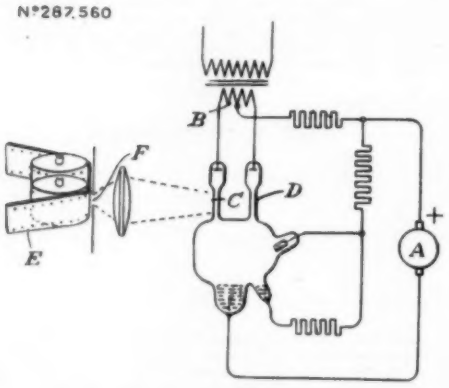


which, of course, depends on the specific gravity of the electrolyte. The battery is provided with a side chamber in which the floats are placed. The float A is of such density that it will rise in the electrolyte when the battery is fully charged, whilst the density of the float B is such that it sinks in the electrolyte when the battery is discharged to the safe limit. The manner in which the floats are made to close the indicating circuits is obvious from the drawing.—*May 10th*, 1928.

ELECTRICAL APPLIANCES.

287,560. March 16th, 1928.—IMPROVEMENTS RELATING TO VARIABLE LIGHT-PRODUCING APPARATUS INCLUDING AN ELECTRIC DISCHARGE LAMP, PARTICULARLY INTENDED FOR SOUND RECORDING, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

As the title of this specification indicates, the invention relates to variable light-producing apparatus, including an electric discharge lamp intended for sound recording. The apparatus is particularly adapted for making a photographic film record of sound waves. The arc-maintaining direct current from the source A divides at the secondary B of the transformer the two parts traversing the two tubes C and D in parallel. The variable or sound current, however, from the secondary B, being the

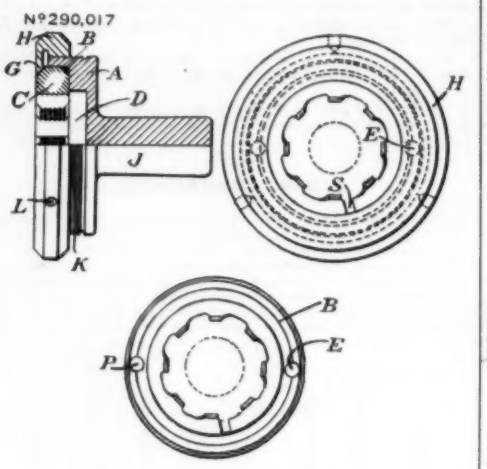


controlling current, traverses the tubes in series, hence at any given instant it augments the direct current in one tube and reduces it in the other tube, the net current passing either tube at any instant being the algebraic sum of the two currents at that instant. Light from one tube only, namely, tube C in the illustration, reaches the film E through the narrow aperture F. The other tube D then forms a low-resistance return path for the sound current, since an arc is maintained at all times in that tube as well as in tube C, whereby a large step-down in the ratio of the transformer may be used, resulting in a corresponding increase in the modulation of the exciting current traversing tube C. The term "light" is intended to be given its broadest interpretation and not to be restricted to that narrow band of vibrations comprising the visible spectrum.—*May 10th*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

290,017. April 6th, 1927.—IMPROVEMENTS IN OR RELATING TO SCREWING DIES, John Harper and Co., Ltd., of Albion Works, Willenhall, Stafford; and Meshach Collett, of the same address.

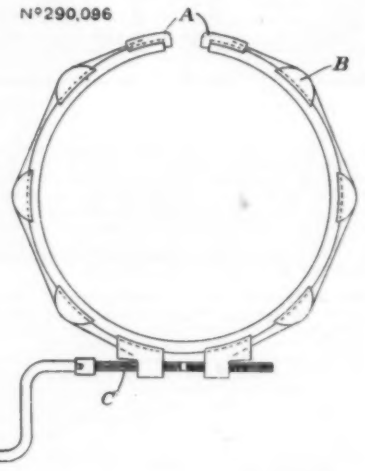
This invention relates to screwing dies each formed in one piece with a radial cut-out portion to allow for adjustment. A is the head provided with a sinking B to receive the screwing die C and also with a further sinking D to allow for the forward movement of the work to be screwed. The die C is formed with a split S and with two half-round notches E on its periphery, and these half-round notches are arranged to come opposite to correspondingly placed half-round notches formed in the inner surface of the wall of the sinking B. Dowel pegs P engage in these half-round notches and prevent the die from rotating in relation to the head. The die projects a considerable distance forwards from the sinking B and is provided at its outer edge with a taper G which is adapted to engage with an internal taper of an internally screwed ring H which is adapted to screw on to an external screw thread K of the head A. Holes L are formed in the periphery of the ring H to facilitate its being tightened up by a suitable tool. When the die is put in position in the head with the pegs P inserted and the ring H screwed up the internal taper of the latter compresses the die, closing it up to the required degree; and, during the screw-cutting operation, there is no tendency for the die to be further decreased in diameter. It will



be seen that the die is formed with a taper at its inner face. This is to enable it to be reversed in the head, so that it can be used for screw-cutting from both faces. J is a shank for driving the head from a suitable screwing machine; but, if desired, the head may be constituted as a stock provided with the usual long radial handles.—*May 10th*, 1928.

290,096. September 28th, 1927.—EXPANDING TOOL FOR PISTON RINGS, Tage Madsen, of 30, Stampgatan, Göteborg, Sweden.

This specification describes an expanding tool for split piston rings, consisting of a band applied round the ring and provided with hooks A at its ends to engage with the ends of the ring as

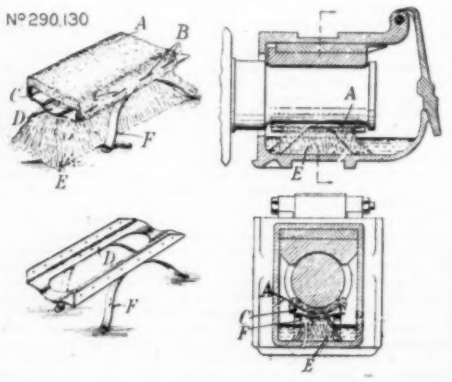


shown. Lugs are also provided around the band as shown, for example, at B. The band is in two parts, held together by means of the stretching device C for the purpose of opening the ring. The inventor contends that the usual method of threading piston rings over pistons often results in damage to the rings, and the tool described has been devised to overcome this trouble.—*May 10th*, 1928.

MISCELLANEOUS.

290,130. December 12th, 1927.—IMPROVEMENTS IN OR RELATING TO AXLE AND LIKE LUBRICATING MEANS, W. M. Still and Sons, Ltd., and Frederick Guy Still, both of 29, Charles-street, Hatton-garden, London.

The pad A is secured by staples B or other lacing to flanges C



of a plate D, from which the capillary strands E emerge. Springs F are connected to the plate, and cause the plate to assume the form shown in the lower right-hand drawing. Obviously, the spring pressure keeps the pad in contact with the journal, the oil being supplied to the pad by capilliary action in the ordinary way.—*May 10th*, 1928.

289,909. November 5th, 1926.—PROCESS FOR THE PRESERVATION OF MINERAL OILS, Dr. Fritz Hofmann, of Novastrasse 15, Breslau, Germany, and Dr. Manfred Dunkel, of Morgenzeile 1, Breslau, Germany.

It is known that under the influence of atmospheric oxygen at elevated temperatures mineral oils, especially lubricating oils and transformer oils, become discoloured and darken, owing to oxidation, and a sludge separates. Many oils also become polymerised under such conditions. The object of this invention is to preserve these oils. According to this invention a cyclic amine of high alkalinity is added to the oil, whereby oxidation is restrained or retarded. The following examples illustrate the use of specific organic compounds employed according to this invention:—(1) Piperidine: A mineral oil which yields 2·8 per cent. of oxidation products after seventy-two hours' heating with the passage of oxygen, in a similar test, after the addition of 0·1 per cent. of piperidine, gives only 0·65 per cent. of oxidation products. (2) Diethylaniline: The same oil, treated with 0·1 per cent. of diethylaniline, gives 0·6 per cent. of oxidation products. (3) Phenylene diamine: The same oil, treated with 0·1 per cent. of phenylene diamine, gives 0·86 per cent. of oxidation products.—*May 7th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

MONDAY TO WEDNESDAY, JUNE 18TH TO 20TH.

THE INSTITUTION OF HEATING AND VENTILATING ENGINEERS—Summer meeting at Blackpool.

TUESDAY, JUNE 19TH.

JUNIOR INSTITUTION OF ENGINEERS.—All-day visit to the Dunlop Rubber Company's works at Fort Dunlop.

WEDNESDAY, JUNE 20TH.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Visit to G. and T. Earle's Humber cement works.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington, S.W. 7. The following papers and memoir will be taken:—(1) "Report on the Phenological Observations in the British Isles, December, 1926, to November, 1927," by J. Edmund Clark, I. D. Margary, R. Marshall, and C. J. P. Cave; (2) "On the Relation Between Temperature Changes and Wind Structure in the Upper Atmosphere" (*Memoirs*, Vol. 1, No. 7), by C. K. M. Douglas; (3) "Simple Formulæ for Computing Relative Humidity," by R. M. Poulter. 5 p.m.

FRIDAY, JUNE 22ND.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the works of the Gramophone Company, Ltd., at Hayes.

MONDAY TO FRIDAY, JUNE 25TH TO 29TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer meeting at Southampton. On Tuesday, 26th, a paper, "The Port of Southampton," will be read by F. E. Wentworth-Sheilds, O.B.E.

TUESDAY TO SATURDAY, JUNE 26TH TO 30TH.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Summer meeting at Scottish Centre.

WEDNESDAY, JUNE 27TH.

THE INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION. Visit to Bilsthorpe Colliery. Leave New-street Station, Birmingham, by the 10.15 a.m. train.

SATURDAY, JULY 7TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to Messrs. Fletcher, Russell and Co.'s Palatine Works, Warrington. 3 p.m.

TUESDAY, JULY 10TH.

THE INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Local summer meeting. A summer visit to D.P. Battery Company, Ltd., Bakewell, Derbyshire; Haddon Hall; and the Derbyshire and Nottinghamshire Electric Power Company's outdoor sub-station, Ambergate. Assemble Grand Hotel, Birmingham, 8.50 a.m.

CONTRACTS.

BRAITHWAITE AND CO., ENGINEERS, Ltd., Broadway Buildings, Westminster, S.W., have received an order from the Government of Sarawak for a pressed steel tank of 2¼ million gallons capacity.

THE BRITISH SECHERON COMPANY, Ltd., of Abbey House, 2, Victoria-street, Westminster, has received an order for what is claimed to be the largest Diesel electric locomotive of its class yet constructed. This locomotive, which is for Russia, will be of the 2–10–2 type, and will be equipped with two Diesel engines made by Sulzer Brothers, having a total output of 1500 H.P.

STONEWARE PIPE WORKS AT ERITH.—In connection with the description of the new pipe works of Messrs. Doulton, which appeared in our issue of May 18th, we are informed by the Ewart Chainbelt Company, Ltd., of Colombo-street, Derby, that several of the elevators we illustrated, viz., those used in connection with the main grinding mill, the grog mill and the pipe-making machines were supplied by that company.

PERMANENT FUEL ECONOMY EXHIBITION.—We are informed that a permanent Fuel Economy Exhibition is being organised in London and will be opened during September next. The aim of the promoters is to collect under one roof exhibits from the leading firms of this country which specialise in the construction of plant or appliances directly connected with the preparation and the utilisation of fuel in all its various forms.

THE INSTITUTION OF ELECTRICAL ENGINEERS: LONDON STUDENTS' SECTION.—The annual summer meeting of the London Students' Section of the Institution of Electrical Engineers will be held in Holland and Western Germany. The party will leave London on Saturday evening, July 28th, for Rotterdam, where two days will be spent. Visits have been arranged to works at Rotterdam, Eindhoven and Utrecht, and a pleasure trip to The Hague. In Germany visits have been arranged to works of engineering interest at Essen, Dusseldorf and Cologne. The party will return from Cologne on the evening of August 6th, arriving in London on August 7th.